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NEW OR NOTEWORTHY PHILIPPINE ORCHIDS, II

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TWENTY-NINE PLATES

The present contribution is, like the preceding one,[1] the result of further studies of those orchids in the Philippines that appear to deserve recognition as being new. Five species, which have been described previously, are here recorded and redescribed, one of these from the Archipelago for the first time. Five species and two varieties are here proposed as new. The arrangement of the genera follows the sequence proposed by Pfitzer in Engler and Prantl's "Die natürlichen Pflanzenfamilien." All the illustrations and descriptions have been prepared from living specimens. The colored illustrations and ink sketches were made by Messrs. J. M. Salazar and P. Ramos, draftsmen of the division of botany, Bureau of Science. Unless otherwise indicated in the text, the types of the new species and varieties have been deposited in the herbarium of the Bureau of Science, with the isotypes in the herbarium of the senior author.

Genus AGROSTOPHYLLUM Blume

AGROSTOPHYLLUM LUZONENSE sp. nov. Plates 1, 4, 13, and 14.

Herba epiphytica, caules 21 ad 40 cm longi, ad basim 2 ad 2.5 mm in diametro, fasciculati, teretes, erecti, superne vaginis

[1] Philip. Journ. Sci. 44 (1931) 369.

foliorum haud dilatati; vaginae foliorum imbricatae, persistentes, nitidae, stramineae, prope apicem caulis haud inflatae (in vivo et in sicco), marginibus flavidis; nodi 1 ad 2 cm distantes. Folia usque ad 9 cm longa, prope basim 5 ad 6 mm lata, linearia, acute acuminata, ad basim torta. Inflorescentia terminalis capitata, multiflora, 1.5 ad 2 cm in diametro. Bracteae exteriores inflorescentiam amplectentes, rigidae, lanceolatae, floribus longiores; bracteae florales obtusae, floribus breviores, glumaceae. Pedicelli cum ovario 6 ad 7 mm longi. Sepala lateralia ovato-lanceolata, tenuiter acuminata, obliqua, trinervia, circiter 6 mm longa, ad basim 3 mm lata. Sepalum dorsale simile. Petala lineari-lanceolata, circiter 5 mm longa, ad basim 1.5 mm lata. Labellum carnosum, ad basim leviter saccatum, saccus antice in laminam retusam productus, 7 mm longum; epichilium deltoideo-ovatum, circiter 5 mm longum, 4.5 mm latum, acutum, margine involutum, leviter apiculatum, expansum minute trilobatum. Gynostemium circiter 5 mm longum, rostellum ovatum, sulcatum. Pollinia 8.

An epiphyte; the roots very numerous, 1.5 to 2 mm in diameter. Stems tufted, erect, terete, slender, 21 to 40 cm long, 2 to 2.5 mm in diameter at the base, forming large clumps up to 30 cm in diameter; the nodes 1 to 2 cm distant, light green and entirely covered by the straw-colored persistent leaf sheaths. The leaf sheaths not inflated above both in the living and in the dried specimens, the margins yellowish. Leaves restricted to the upper portion of the stems, distichous, the bases twisted, linear, acutely acuminate, up to 9 cm long, 5 to 6 mm wide at the base, the very apex sharply triapiculate. Inflorescences terminal, capitate, many-flowered, not very dense, composed of short spikes, 1 to 2 cm in diameter; flowers 1 to 3 on a spike, opening simultaneously, about 1 cm across. Peduncles about 5 mm long. Exterior bracts sheathing the inflorescence, rigid, lanceolate, longer than the flowers, the floral ones glumaceous, obtuse, shorter than the flowers. Pedicellate ovary 6 to 7 mm long. Lateral sepals ovate-lanceolate, oblique, sharply and acutely acuminate, three-nerved, about 6 mm long, 3 mm wide at the base. Dorsal sepal similar to the lateral ones. Petals linear-lanceolate, three-nerved, acute, about 5 mm long, 1.5 mm wide at the base. Labellum fleshy, constricted near the middle, the basal part saccate, about 7 mm long; the epichile deltoid-ovate, acute, about 5 mm long, 4.5 mm wide, the margins involute, minutely trilobed at the apex when expanded. Column short and broad, abruptly constricted in the middle with a fleshy

semiorbicular process in the basal half, narrowly bialate above, about 5 mm long, foot short but distinct. Pollinia clavate, 8.

LUZON, Manila, Bureau of Science orchid house, *Bur. Sci. 80833 Quisumbing,* August 25, 1930. The living plants were collected from the mountains between Siain and Atimonan, Tayabas Province, growing at medium altitudes on tree trunks. They thrive best in wooden baskets. The flowers are marguerite yellow [2] except the purple marginal wings of the column.

This species is manifestly allied to *Agrostophyllum malindangense* Ames, which it closely resembles in vegetative characters. It differs notably in its leaf sheaths not being inflated and expanded, particularly at the apical portion of the stem, its inflorescences not being densely capitate, and in having much larger flowers and differently shaped flower parts.

In the herbarium of Oakes Ames are two plants, with mature flowers, that must be referred to this species. The data are Nueva Vizcaya Province, Luzon, *J. de Veyra,* September 25, 1916, and the plants are said to be tufted and epiphytic.

Genus SPATHOGLOTTIS Blume

SPATHOGLOTTIS PLICATA Blume var. PARSONSII var. nov. Plates 1, 15, and 17, fig. 1.

Pseudobulbi ovoidei, 5 ad 7 cm longi, prope basim 3.5 ad 5 cm in diametro, valde rugosi. Folia lanceolata vel elliptico-lanceolata, acuminata, 57 ad 70 cm longa, 9 ad 13.5 cm lata, in sicco conspicue nervosa. Pedunculus 50 ad 70 cm longus, erectus vel arcuatus, superne minute tomentosus. Flores 4.5 ad 5 cm in diametro. Labellum spici simile, circiter 2 cm longum, apicem retusum.

A variety resembling the species in habit. Pseudobulbs large, ovoid, 5 to 7 cm long, 3.5 to 5 cm in diameter at the widest portion, conspicuously rugose. Leaves lanceolate or elliptic-lanceolate, acuminate, 57 to 70 cm long, 9 to 13.5 cm wide, the nerves very prominent, particularly when dried. Peduncles 50 to 70 cm high, rigid, erect, sometimes curved, minutely white-tomentose. Flowers 4.5 to 5 cm across, pale ochraceous-salmon or salmon-orange, flushed with mallow pink or pale rosolane purple. Sepals ovate-lanceolate, obtuse, 1.9 to 2 cm long, 9 to 10 mm wide, pubescent on the outer surface. Petals elliptic-ovate or oval, obtuse, 2 to 2.2 cm long, 1.4 to 1.5 cm wide. Pedicellate ovary tomentose, chrysolite green. Labellum about 2 cm long, three-lobed; lateral lobes oblong-obovate, broadly rounded,

[2] The color terms used are mostly from Ridgway's Color Standard and Color Nomenclature (1912).

oblique, the front lobe approaching that of *Spathoglottis plicata* in form, trilobulate, reniform and retuse at the apex with a long cuneate claw, straw-yellow or light salmon-orange, splashed at the middle with old rose or flame scarlet, the claw lemon chrome, the pair of side lobules at the base lemon chrome spotted with old rose, pubescent, white, triangular-acute, callus between the lobules lemon chrome or empire yellow and grenadine red, glabrous.

LUZON, Rizal Province, Pasay, Mrs. Geo. H. Fairchild's gardens, *Bur. Sci. 79663 Quisumbing*, August 22, 1930. The living plants were originally collected by Mr. Emilio Ermitaño, an orchid grower and dealer of Manila, from the grasslands below the Cañon Road, Baguio, Mountain Province, in February, 1929, and sold to Mr. W. Parsons, who has the plants now in his gardens at Geneva, Switzerland. The same variety was again collected by Mr. Ermitaño from about the same locality, in February, 1930, and sold to Mrs. Geo. H. Fairchild.

The new variety appears to be a natural hybrid between the light purple *Spathoglottis plicata* Blume and the yellow *Spathoglottis vanoverberghii* Ames. The floral structure and form resemble those of *S. plicata* Bl. The pubescence of the peduncles, pedicels, and outer surface of the sepals, however, is a feature of *S. vanoverberghii* Ames. The variety is readily distinguished from the two species by the color of the flowers. This variety is named in honor of Mr. W. Parsons, who, during his residence in Manila, courteously placed the facilities of his orchid collection at the disposal of the junior author. Mr. Parsons, at his home in Genthod, near Geneva, has now the best and largest collection of Philippine orchids in Switzerland.

Genus DENDROBIUM Swartz

DENDROBIUM BATANENSE sp. nov. Plates 1, 5, 16, and 17, fig. 2.

Caules aggregati, elongati, 9 ad 24 cm alti, supra graciles, vaginis foliorum obtecti. Pseudobulbi teretes, angulati; internodia plerumque 2 vel 3, 10 ad 21 mm longi. Folia disticha, ensiformia, lineari-lanceolata, valde complanata, acuta, 4 ad 6.5 cm longa, 3.5 ad 6 mm lata, 1.5 ad 3 cm inter se distantia. Flores albidi, circiter 2.5 cm longi, 2.5 cm in diametro. Sepala lateralia oblique oblongo-lanceolata, acuta vel obtusa, circiter 19 mm longa, 5 mm lata, 7-nervia, mentum obtusum, circiter 7 mm longum, formantia. Sepalum dorsale anguste oblongo-lanceolatum, subacutum, circiter 13 mm longum, 5 mm latum, 7-nervium. Petala anguste-oblanceolata vel elliptico-lanceolata, obtusa vel

acuta, circiter 12 mm longa, 4 mm lata, 3-nervia. Labellum a basi cuneata, trilobatum, circiter 16 mm longum; lobi laterales triangulares, obtusati vel acuti, trans apicem circiter 3 mm lati; lobus intermedius in circuitu suborbicularis, circiter 1 cm longus, margine fimbriato. Lineae 3 elevatulae per discum et ultra medium callus cristatus pubescens. Gynostemium sectionis. Capsula anguste ellipsoidea, circiter 3 cm longa, 6 mm in diametro.

The stems aggregated, elongate, 9 to 24 cm long, concealed by leaf sheaths. Pseudobulbs terete, angled; internodes usually 2 or 3, 10 to 21 mm long. Leaves distichous, linear-lanceolate, acute, flattened, 4 to 6.5 cm long, 3.5 to 6 mm wide. Flowers produced along the naked termination of the stems, white, very fragrant, about 2.5 cm long, 2.5 cm across. Lateral sepals obliquely oblong-lanceolate, acute or obtuse, about 19 mm long along the anterior margin, 5 mm wide, 7-nerved, forming an obtuse mentum about 7 mm long. Dorsal sepal narrowly oblong-lanceolate, subacute, about 13 mm long, 5 mm wide, 7-nerved. Petals narrowly oblanceolate or elliptic-lanceolate, obtuse or acute, about 12 mm long, 4 mm wide, 3-nerved. Labellum cuneate at the base, about 16 mm long, trilobed; lateral lobes triangular, obtuse or acute, about 3 mm wide across the apex, lined within with purple; the middle lobe suborbicular in outline, about 1 cm long, the margins conspicuously fringed like the labellum of *Dendrobium polytrichum* Ames. The throat deep chrome at the base, the pubescent disc with three elevated lines. Gynostemium white, about 10 mm long, tridentate at the apex. Capsule narrowly ellipsoid, about 3 cm long, 6 mm in diameter, subterete, one side somewhat flattened, with three distinct longitudinal ribs.

BATAN ISLAND, Batanes Province, Mount Iraya, *Bur. Sci. 79934 Ramos,* April 29, 1930, growing on tree trunks, altitude about 700 meters.

Living plants brought to Manila by Mr. M. Ramos, botanical collector, Bureau of Science, are now growing in the Bureau of Science orchid house and flower throughout the year. The plants when first brought to Manila flowered twice in September, 1930, and have flowered monthly since, and sometimes even twice a month.

In general habit this species has several close allies, particularly *Dendrobium polytrichum* Ames and *Dendrobium carinatum* (L.) Willd., but it differs from both species in details of the lip.

DENDROBIUM FAIRCHILDAE sp. nov. Plates 2, 7, 18, and 19.

Caules aggregati, elongati, basi attenuati, folia lanceolata, acuta, 13 ad 17 cm longa, 1.5 ad 2.6 cm lata, gerentes. Racemi brevissimi, 7-vel 8-flori, e caulibus defoliatis orientes. Flores circiter 5 cm longi, 4 cm lati. Sepala lateralia obliquissime triangulari-ovata, in apice cucullata, 1.8 ad 2.4 cm longa, secundum columnae pedem 2.5 ad 3 cm lata; mentum valde elongatum, superne abrupte reflexum. Sepalum dorsale ovato-lanceolatum, obtusum vel subacutum, 1.8 ad 2.6 cm longum, 9 ad 12.5 mm latum. Petala oblongo-elliptica, obliqua, in apice rotundata, 1.8 ad 2.4 cm longa. Labellum perbreviter, 3.3 ad 4 cm longum, obscurissime trilobum; lobi laterales breves, erecti, late rotundati; lobus intermedius productus late ovatus, abrupte acutus, reflexus, discus glaber.

Stems terete, aggregated, elongate, 66 to 95 cm tall, leafy, 7 to 10 mm in diameter at the middle, 3 to 5 mm across at the base; the nodes 1.5 to 4.5 cm distant. Leaves distichous, deciduous, lanceolate, acute, 13 to 17 cm long, 1.5 to 2.6 cm wide, 9-nerved, membranaceous, greenish, articulated to tubular sheaths. Leaf sheaths up to 4.5 cm long, membranaceous, deciduous on the lower part of the plant. Flowers 7 or 8, in very short lateral racemes, about 5 cm long, 4 cm across, with a strongly curved spur. Peduncles sheathed, about 5 mm long below the flowers, the rachis about 1.5 cm long, glabrous. Bracts lanceolate, purplish, up to 5 mm long. Pedicellate ovary 3.5 to 4 cm long, pale flesh color, pedicel slender. Lateral sepals very obliquely triangular-ovate, obtuse or subacute, somewhat cucullate at the tip, 1.8 to 2.4 cm long, about 2.5 to 3 cm wide along the column-foot. Dorsal sepal cucullate, reflexed, ovate-lanceolate, obtuse or subacute, 1.8 to 2.6 cm long, 9 to 12.5 mm wide, 7-nerved. Petals oblong-elliptic, oblique, rounded at the tip, 1.8 to 2.4 cm long, 1 to 1.2 cm wide, 7-nerved, margin entire. Labellum very shortly unguiculate, 3.3 to 4 cm long, cuneate-obovate, narrowed to the base, sharply bent at the base to conform to the curved spur formed by the mentum of the lateral sepals, very obscurely 3-lobed; the lateral lobes erect, broadly rounded; the front lobe produced, broadly ovate, abruptly acute, about 1.8 cm wide at the broadest portion, reflexed; the disc glabrous with a small hippocrepiform callus at the base. Column white, very short and stout, about 5 mm long, extended in an elongate foot.

The flowers are odorless, white with the apices of the petals and the labellum flushed with mallow pink or phlox purple; the

spur white with shades of mallow pink or phlox purple, the anther cap marguerite yellow and the base of the labellum primuline yellow.

LUZON, Rizal Province, Pasay, Mrs. Geo. H. Fairchild's gardens, *Bur. Sci. 80820 Quisumbing*, October 2, 1930. The plants were originally collected near Kilometer 42, Mountain Road to Bontoc, Mountain Province, growing on exposed rocks and they are now under cultivation in Mrs. Fairchild's gardens.

This species belongs in the group with *Dendrobium ramosii* Ames, *D. o'brienianum* Kränzl., and *D. epidendropsis* Kränzl. It is especially close to the first, but differs radically in being a much larger plant with very much larger flowers with dissimilar floral details.

The species is dedicated to Mrs. Geo. H. Fairchild, an orchid enthusiast with large collections in her gardens at Pasay, near Manila, and in Baguio. Through her untiring interest in Philippine orchids, she has succeeded in cultivating many of the beautiful, rare, and wild orchids of these Islands.

DENDROBIUM JUNCEUM Lindl. Plates 2, 8, 20, and 21.

Dendrobium junceum LINDL. in Bot. Reg. 28 (1842) Misc. p. 9, No. 11; REICHB. f. in Walp. Ann. 6 (1861) 281, Gard. Chron. (1873) 361; KRÄNZL. in Engl. Pflanzenreich IV. 50. II B. 21 (1910) 240.

Caules aggregati, supra parce ramosi, usque ad 115 cm longi; pars basalis 5 ad 15 cm longa, fusiformis, incrassata, sulcata, 1.5 ad 2.5 cm crassa; cum 3 internodiis 1.5 ad 3.5 cm longis; pars superior gracilis, teres, 2 ad 3 mm in diametro. Folia subteretia, sulcata, filiformia, subulata, 8 ad 16 cm longa, 1.5 ad 2.5 mm in diametro. Flores fugaces, viridi-flavicum, labello purpureo-striato, in apice caulium et in axillis foliorum spueriorum singuli orientes, 3.5 ad 4 cm longi, 3 ad 4 cm lati; bracteae breves hyalinae; ovarium cum pedicello 1.6 ad 1.8 cm longum. Sepala lateralia latissime triangularia, obliquissima, acuta, basi anteriore dilatata, mentum obtusum formantia, 1.8 ad 2 cm longum. Sepalum dorsale triangulari-lanceolatum vel ovato-lanceolatum, acutum, 1.5 ad 1.8 cm longum, 0.9 cm latum, 5-vel 7-nervium. Petala ovato-lanceolata, acuta, circiter 1.4 cm longa, 0.6 cm lata, 3- ad 7-nervia. Labellum prope apicem trilobum, e basi cuneata, obovatum, 2.3 ad 2.5 cm longum; lobi laterales late triangulares; lobus intermedius major quam laterales, semiorbicularis, margine crispatus et minute crenulatus, papillosus. Discus per partem basalem leviter tricarinatus, carinae antice in faeciam singulam carnosam productum. Gynos-

temium crassum, perbreve, superne tridentatum, in pedem elongatum extensum.

Stems rather tall, branching sparingly near the top, up to 115 cm long, pseudobulbous at base; lower part 5 to 15 cm long, fusiform, enlarged at the middle and tapering at both ends, conspicously ridged, 1.5 to 2.5 cm in diameter with 3 internodes 1.5 to 3.5 cm long; upper part slender, terete, 2 to 3 mm in diameter, greenish olive or reddish brown. Leaves subterete, channelled, filiform, subulate, 8 to 16 cm long, 1.5 to 2.5 mm in diameter, dark green. Flowers produced singly from tufts of bracts along the naked termination of the stems or from the axils of upper leaves, 3.5 to 4 cm long, 3 to 4 cm across. The bracts small, hyaline. Pedicellate ovary 1.6 to 1.8 cm long. Lateral sepals very broadly triangular, very oblique, as long as the dorsal sepal, forming with the column-foot a spur that is stout, rather recurved, obtuse, 1.8 to 2 cm long. Dorsal sepal triangular-lanceolate or ovate-lanceolate, acute, 1.5 to 1.8 cm long, 0.9 cm wide, 5- to 7-nerved. Petals ovate-lanceolate acute, about 1.4 cm long, 0.6 cm wide, 3- to 7-nerved. Labellum trilobed near the apex, cuneate at the base, obovate, 2.3 to 2.5 cm long; lateral lobes broadly triangular; the middle lobe larger than the lateral lobes, semiorbicular, notched at the apex, crisped, the margins minutely crenulate, papillose. Disc through the basal part lightly tricarinate, the keels produced in front into a single fleshy band. Column very short and stout with three teeth at the apex, extended into an elongated foot.

LUZON, Manila, Bureau of Science orchid house, *Bur. Sci. 79065 Quisumbing*, May 24, 1930, the living plants being originally collected at Atimonan, Tayabas Province.

The flowers open one at a time on the nodes along the naked termination of the stems or in the axils of apical leaves and are very fragrant, the odor approaching that of *Dendrobium crumenatum* Sw. In habit the flowers differ from those of *D. crumenatum* Sw. in that they remain fresh on the plant for several days. The sepals, petals, spur, and pedicellate ovary are chartreuse yellow with some cream color at the apices of the petals and sepals. The lateral lobes of the labellum including the cuneate base are white, the reticulations are dark rhodamine purple or true purple, the middle lobe of the labellum and the disc are chartreuse yellow. The plants first flowered in the Bureau of Science orchid house June 1, 1929, and again May 24, 1930.

Dendrobium junceum Lindl. was supposed in the original description to have come from Singapore, but Ridley [3] doubts this origin and says that "what I take to be the plant intended I received from Manila, sent by Sr. Vidal." A record of the type of *D. junceum* together with the sketch of the lip in the herbarium of Oakes Ames shows an identical species beyond question. The flowers of the plants from Tayabas are larger than those of the type specimen in Lindley's herbarium, but similar to them in all salient points. The labellum in our material is not so prominently 3-lobed as represented in Lindley's sketch, yet the central carina and the surface of the middle lobe exhibit no marked difference from the type material as interpreted by Lindley. In habit *D. polytrichum* Ames resembles this species closely.

DENDROBIUM MODESTUM Reichb. f. **Plates 1, 6, and 22.**

Dendrobium modestum Reichb. f. in Bonpl. 3 (1855) 222, in Walp. Ann. 6 (1861) 281; Naves, Novis. App. (1882) 234; Kränzl. in Engl. Pflanzenreich IV. 50. II. B. 21 (1910) 220; Ames, Orch. 5 (1915) 128, in Merr. Enum. Philip. Fl. Pl. 1 (1924) 352.

Species *D. aciculari* Lindl. et *D. philippinensi* Ames affinis. Planta epiphytica 30 ad 55 cm alta. Caules purpurei; pars basalis per 7 ad 13.5 cm longa, fusiformi-incrassata, 8-angulata, 5 ad 7 mm in diametro; pars superior teres, gracilis, 1.5 ad 2 mm crassa; internodia prope basim usque ad 4.5 cm longa. Foliorum vaginae cylindriceae, internodiis aequilongae. Folia teretia, acicularia vel subulata, acuta, adscendentia, glabra, carnosula, rigidiuscula, 5.5 ad 10.5 cm longa, 1.75 ad 2.5 mm in diametro, quam internodia plerumque longiora. Flores pauci, pallide purpurei, singuli, versus apicem caulis. Bracteae quam ovarium pedicellatum breviores. Pedicellum cum ovario circiter 7 mm longum, gracile. Sepala lateralia latissime et obliquissime triangularia, acuta, circiter 7 mm longa, 7 mm lata secundum columnae pedem, 3- ad 5-nervia, mentum obtusum formantia. Sepalum dorsale triangulari-lanceolatum, acutum, circiter 6.5 mm longum, in basi 3 mm latum, 5-nervium. Petala anguste elliptica, obtusa, circiter 6.5 mm longa, 1.75 mm lata, 1-nervia. Labellum e basi sensim cuneata dilatatum, prope apicem leviter trilobatum, circiter 12 mm longum; lobi laterales antice subrotundati, denticulati, circiter 1.5 mm lati; lobus intermedius subquadratus, antice subrotundatus, denticulatus, in apice api-

[3] Journ. Linn. Soc. 32 (1896) 250.

culatus. Discus lineis 3, nervisque purpureis, parallelis percursus. Gynostemium perbreve, in pedem elongatum extensum.

An epiphyte 30 to 55 cm high. The stems flushed with purple; the lower part pseudobulbous, angled, much thickened, consisting of three internodes which are up to 4.5 cm long and 5 to 7 mm in diameter; the upper part terete, 1.5 to 2 mm in diameter. The leaf sheaths cylindrical, as long as the internodes. Leaves terete, acicular or subulate, acute, 5.5 to 10.5 cm long, 1.75 to 2.5 mm in diameter, ascending, glabrous, rather fleshy and rigid, flushed with brownish purple. Flowers odorless, few, pale purple, appearing singly at the extremities of the stems. The bracts minute and very much shorter than the pedicellate ovary. Pedicellate ovary slender, about 7 mm long. Lateral sepals very broadly and obliquely triangular, acute, about 7 mm long, 7 mm wide along the column-foot, 3- to 5-nerved, forming an obtuse spur. Dorsal sepal triangular-lanceolate, acute, about 6.5 mm long, 3 mm wide at the base, 5-nerved. Petals narrowly elliptic, obtuse, about 6.5 mm long, 1.75 mm wide, 1-nerved. Labellum gradually cuneate at the base, dilated somewhat at the apex, lightly trilobed beyond the middle, about 12 mm long; lateral lobes subrounded, denticulate, about 1.5 mm wide across the apex; middle lobe subquadrate, denticulate, the apex very broadly rounded and apiculate, about 2.5 mm long, 3.5 mm wide. Disc traversed by three distinct parallel lines, which are conspicuously purple. The column very short, tridentate at the apex, extended into an elongate foot.

CORON ISLAND, Palawan Province, *Bur. Sci. 78800 W. H. Brown*, December 24, 1929. Living plants were collected by Dr. William H. Brown, director of the Bureau of Science, Manila, during a trip to Coron Island, while en route to Culion Leper Colony, situated on Culion Island, Palawan Province. These plants were found growing as an epiphyte on small trees on cliffs along the shore, and are now being cultivated in the Bureau of Science orchid house.

Dendrobium modestum Reichb. f. has heretofore escaped all modern collectors. However, a record in the herbarium of Oakes Ames shows a sketch from the herbarium of Reichenbach that represents unmistakably a species similar to the one from Coron Island. A minor discrepancy appears in the short, scarcely uncinate lateral teeth of the column.

Genus BULBOPHYLLUM Thouars

BULBOPHYLLUM CLEISTOGAMUM Ridl. Plates 3, 9, and 23.

Bulbophyllum cleistogamum RIDL. in Journ. Linn. Soc. 31 (1896) 277, Fl. Malay Penin. 4 (1924) 69; CARR in Gard. Bull. Straits Settlements 5 (1930) 139, *t. 2, f. 5.*

"Rhizoma pseudobulbis pluribus approximatis tectum; pseudobulbi *conici* sulcati, 3/4 pollices longi, laete virentes. Folium oblongum petiolatum subacutum, canaliculâ distinctâ, carinâ dorsali paullo elevatâ, 4–6 pollices longum, 3/4–1 pollicem latum, petiolo profunde canaliculato, 1/2 poll. longo. Scapi plures rigiduli teretes, ad 12 pollices longi, virides, bracteis siccis subacutis, 1/2-pollicaribus arcte amplectentibus. Racemus breviusculus complanatus, bracteis ovatis acutis, mucronatis, 1/4-pollicaribus amplectentibus. Flores mediocres *cleistogami*, saepissime clausi, raro paullo expansi. Sepala *lanceolata acuminata* acuta, pallide straminea, 3/4 poll. longa, lateralia basi dilatata intus rubescentia. Petala *minuta quadrata* subdenticulata, mucrone subulato longiusculo, viridia. Labellum *elongatum curvum acutum*, basi latâ, lobis duobus lateralibus parvis falcatis, carinis duabus approximatis a basi usque ad geniculatum, basi kermesinum, apice stramineum. Columna brevis crassa viridis, margine clinandrii denticulato. Stelidia *subulata erecta*, pede kermesino haud producto. Anthera ovata. Rostellum *nullum*." Ridley, l. c.

Rhizomes creeping, branched, 3 to 5 mm in diameter, clothed with dry tubular sheaths, which later become fibrous; internodes 3 to 5 mm long. Pseudobulbs 1-leaved, cylindric-conic, usually curved, 2 to 3.5 cm long, 1 to 1.5 cm in diameter at the base, 0.7 to 2.5 cm distant, wrinkled and longitudinally grooved. Leaves dark green, more or less erect, oblong, oblong-lanceolate or oblong-elliptic, acute, 14.5 to 17.5 cm long, 3.5 to 4.5 cm wide; petioles grooved, 1 to 2 cm long. Inflorescences arising from the base of the pseudobulbs, more or less erect; the peduncles greatly elongated, terete, green suffused with dark purple, 50 to 61 cm long, 1.5 to 2 mm in diameter, clothed at every node with a tubular sheath. Bracts triangular, acute, 7 to 9 mm long, strongly keeled on the back. Flowers odorless, appearing singly at intervals of several weeks, widely expanded, 4 to 4.5 cm across; pedicellate ovary 1.5 to 2 cm long. Sepals spreading, chartreuse yellow tinted with pale vinaceous; the veins, reticulations, and margins dull dark purple. Lateral sepals falcately

triangular-lanceolate, acutely acuminate, 2 to 2.5 cm long, 7 to 8 mm wide, dorsally carinate, 9-nerved. Dorsal sepal erect, oblong-lanceolate, acutely acuminate, about the same size as the sepals, 7- to 9-nerved. Petals very small, 1-nerved, ovate-subquadrate, about 2 mm long without the cusp, about 3 mm wide near the base, the upper half pectinate, the middle nerve prolonged into a long cusp about 1.7 mm long, pale chalcedony yellow, with three patches of Hay's maroon near the base. Labellum reflexed near the base, maroon, mobile, attached by a minute claw to the foot of the column, fleshy, entire, tongue-shaped, about 2 cm long, the very tip acuminate; the basal portion dilated into a pair of erect auricles terminated on each side by an uncinate lobule, in the groove between the auricles runs a pair of approximate converging keels, the upper portion keeled, convex, tumid-rugulose. Column very short, stout, straw yellow, terminating in a pair of spreading, subquadrate, apically bilobed arms of which the posterior lobe is short-triangular and the anterior lobe is subulate and about 1.5 mm long; clinandrium excavated, transversely elliptic; rostellum wanting, the foot at right angles to the column, about 7 mm long; anther semiorbicular, about 1.5 mm long, naphthalene yellow with a median maroon spot.

LUZON, Tayabas Province, Atimonan, *Bur. Sci. 80829 Quisumbing*, April 6, 1930. The specimens were collected from the Quezon National Park, across the road from Gate No. 2 cottage, growing on a dead, standing tree trunk.

This species, which was originally collected from Riouw (Rhio), Borneo, and later reported also from the Malay Peninsula (Perak, Waterloo and Tahan), is new to the Philippines.

Bulbophyllum cleistogamum Ridl. is distinct from any Philippine *Bulbophyllum* by its greatly elongated, slender peduncles and the structure of its flowers, particularly of the labellum, petals, and sepals. The peduncles, indeed, are much more elongated than those previously described.

As Carr [4] points out the designation *cleistogamum* is rather a misnomer, for the flowers are usually widely expanded.

BULBOPHYLLUM MAQUILINGENSE sp. nov. Plates 3 and 10.

Herba epiphytica. Radices fibratae, glabrae. Rhizoma repens. Pseudobulbi conferti, suberecti, ovoidei vel oblongo-ovoidei, 9 ad 16 mm longi, 6 ad 10 mm in diametro, monophylli. Folium ellipticum vel elliptico-oblongum, obtusum, subcoriaceum,

[4] Gard. Bull. Straits Settlements 5 (1930) 139.

1.5 ad 4.5 cm longum, 1 ad 1.5 cm latum. Inflorescentiae erectae, fasciculatae, 1-florae; pedunculus filiformis, 3 ad 5 cm longus; bractea minuta, infundibuliformis, circiter 1.5 mm longa. Pedicellus cum ovario circiter 7 mm longus, gracilis. Sepala lateralia oblique oblonga, acuta, circiter 9 mm longa, 3.5 mm lata, 3-nervia. Sepalum dorsale valde cucullatum, ellipticum, subacutum, 9.5 ad 10 mm longum, 5 ad 6 mm latum, 3-nervium. Petala oblongo-elliptica, acuta vel obtusa, quam sepalum dorsale minora, circiter 7 mm longa, 3 mm lata, 1-nervia. Labellum mobile, lingulatum, carnosum, obtusum, in basi utrinque auriculato-lobatum, vix 6 mm longum, in medio constrictum, parte anteriore spathulata vix 3.5 mm longa; lobi laterales parvi, erecti, vix 1 mm longi, glabri. Gynostemium breve, stelidiis subulatis; anthera subglobosa.

Rhizomes creeping, very slender. Roots fibrous. Pseudobulbs crowded, suberect, ovoid or oblong-ovoid, 9 to 16 mm long, 6 to 10 mm in diameter, smooth or grooved, 1-leaved. Leaves erect, often slightly recurved towards the apex, elliptic or elliptic-oblong, obtuse, 1.5 to 4.5 cm long, 1 to 1.5 cm wide, subcoriaceous, green, sharply sulcate through the middle of the upper surface, with conspicuous median keel beneath; petioles very short, up to 3 mm long. Inflorescences 3 to 8 from the base of each pseudobulb, fascicled, erect, 1-flowered; the peduncles filiform, 3 to 5 cm long. Bracts funnel-shaped, about 1.5 mm long. Pedicellate ovary very slender, about 7 mm long. The sepals cameo pink, barred and mottled with Schoenfeld's purple. Lateral sepals obliquely oblong, acute, about 9 mm long, 3.5 mm wide, 3-nerved, the nerves elevated on the back, inner margins ciliolate and narrowly involute. Dorsal sepal strongly cucullate, elliptic, subacute, 9.5 to 10 mm long, 5 to 6 mm wide, 3-nerved, the nerves elevated on the back. Petals smaller than the sepals, oblong-elliptic, about 7 mm long, 3 mm wide, 1-nerved, olive green barred and mottled with dull dusky purple. Labellum tongue-shaped, blackish red-purple, adnate by a thin claw to the apex of the column-foot, mobile, fleshy, subentire, about 6 mm long, constricted in the middle, the spatulate apex about 3.5 mm long; lateral lobes on each side of the base small, auriculate, erect, about 1 mm long. Column very minute, stelidia subulate; anther subglobose.

LUZON, Laguna Province, Mount Maquiling, *Bur. Sci. 80830 Quisumbing,* April 4, 1930. A glabrous epiphyte, growing on tree trunks, above the second camp.

In the herbarium of the senior author is a sheet of three unnamed plants with a single agglutinated flower the parts of which show that the plants are referable to *Bulbophyllum maquilingense*. The leaves are apparently narrower than those of the type, the smallest being linear-oblong, 2.7 cm long and 4 mm wide. The data of this collection are: LUZON, Tayabas Province, Mount Banahao, *A. D. E. Elmer* (*?*) *3797*, May, 1906. "On undershrubs in the forests at 800 meters; flowers comparatively large, pink, spotted, rare."

Bulbophyllum maquilingense is very similar vegetatively to *B. fenixii* Ames, but it appears to be distinct from all Philippine members of the genus by the strongly cucullate dorsal sepal and the unusual color markings of the flower.

Genus RENANTHERA Loureiro

RENANTHERA STORIEI Reichb. f. var. PHILIPPINENSIS var. nov. Plates 3, 7, and 24.

A specie haec planta parvitate communi, labelli lobis lateralibus angustioribus truncatis et lobo intermedio latiore differt.

Stems erect, terete, dark brown, smaller than in the species, up to 80 cm high, 6 to 7 mm in diameter. The roots greatly elongated, 2 to 5 mm in diameter. Leaves distichous, much smaller than in the species, greenish or greenish yellow (very much paler than in the species, where it is dark green), coriaceous, oblong, unequally bilobed at the rounded apex, 4.5 to 9.5 cm long, 1.5 to 3.4 cm wide. Peduncles 14 to 15 cm long, terete; the bracts tubular, remote, 4 to 5 mm long. Panicles many-flowered (up to 45 flowers). Flowers slightly fragrant, scarlet red, except the bases of the lateral lobes of the labellum which are cream-colored and the base of the middle lobe and the throat of the labellum which are orange, 1.8 to 2 cm wide, 2.5 to 3.2 cm long. Lateral sepals oblong-oblanceolate or oblanceolate, somewhat unguiculate, broadly obtuse or rounded, 1.3 to 2 cm long, 6 to 7 mm wide across the broadest portion, 3- to 5-nerved. Dorsal sepal narrowly oblanceolate, subacute, 1.1 to 1.4 cm long, 3 to 3.5 mm wide, 3- to 5-nerved. Petals narrower and shorter than the sepals, narrowly oblong-oblanceolate or narrowly linear-oblanceolate, broadly obtuse or rounded, 0.9 to 1.3 cm long, 2 to 2.5 mm wide, 3- to 5-nerved. Labellum fleshy, 5 to 6.5 mm long, deeply saccate-spurred at the base; lateral lobes subquadrate, broadly truncate, 1.25 to 1.5 mm long; the middle lobe broadly ovate, subacute, 2.25 to 2.5 mm long, about 2 mm wide; the spur rounded, about 2 mm long. Column

minute, about 2.5 mm long. Anther broadly ovoid, about 1.75 mm across. Pollinia suborbicular.

LUZON, Manila, Bureau of Science orchid house, *Bur. Sci. 78826 Quisumbing*, December 28, 1929. The living plants were collected on trees in mangrove swamps in Aloneros, Tayabas Province, and flowered from October to March. The plants succeed well when nailed on adobe fences, using staples to hold the stems.

This dwarf variety of *Renanthera storiei* differs radically from the species in its small stature, small leaves and flowers, and the narrower broadly truncated lateral lobes of the labellum.

Although the flowers in the variety here proposed are smaller than in the type, it is noteworthy that intergrading forms may appear. In the herbarium of Oakes Ames there is a specimen, *A. Loher 6000*, collected in Rizal Province, with flowers that are equal in size to the largest flowers of var. *philippinensis* with leaves up to 1.5 dm long by 3.8 cm wide. This specimen is clearly referable to var. *philippinensis*.

Genus VANDA Jones

VANDA MERRILLII sp. nov. Plates 3, 11, 25, and 26.

Planta erecta, usque ad 95 cm alta. Folia disticha, parte inferiore imbricantia, rigida, recurvata, lineari-oblonga, oblique bilobata, 25 ad 32 cm longa, 2.8 ad 3.5 cm lata. Inflorescentiae laxae, 7- ad 11-florae, pedunculo incluso circiter 25 cm longae. Flores odoratissimi, 3 ad 3.5 cm in diametro. Sepala lateralia obovata, valde obtusa vel rotundata vel retusa, circiter 1.8 cm longa, 1.3 ad 1.5 cm lata, carnosa, margine valde undulato. Sepalum dorsale simile. Petala subsimilia, leviter unguiculata. Labellum trilobatum, carnosum, in basi in calcar parvum productum; lobi laterales erecti, subquadrati, circiter 3.5 mm longi; lobus intermedius multo major, panduratus, glaber, apice retusus, supra convexus, in basi utrinque auriculatus, circiter 12.5 mm longus, prope basim 12.5 mm latus. Columna abbreviata, crassissima. Pollinia 4, dissimilia, oblique ellipsoidea. Capsula oblongo-obovoidea, profunde carinata, circiter 10 cm longa, 2.5 cm in diametro.

Plant erect, up to 95 cm high. Stems terete. Leaves distichous, linear-oblong, closely imbricated at the base, recurved, rigid, 25 to 32 cm long, 2.8 to 3.5 cm wide, unequally bilobed at the apex, light green, much paler than those of *Vanda luzonica*, which are usually dark green. Racemes 1 to 3 in each plant,

spreading, loosely 7- to 11-flowered, about 25 cm long including the peduncles; the peduncles massicot yellow, rather stout. Flowers very fragrant, fleshy, 3 to 3.5 cm across, nearly as long. Pedicellate ovary massicot yellow, twisted, 3.5 to 6.5 cm long. Bracts broadly ovate, obtuse, up to 5 mm long. Sepals obovate, narrowed to the base, broadly obtuse, rounded or retuse at the apex, strongly undulate, about 1.8 cm long, 1.3 to 1.5 cm wide at the broadest portion, the lateral sepals slightly wider. Petals similar to the sepals in form, lightly clawed, slightly smaller, about 1.8 cm long, 1 to 1.1 cm wide. Labellum trilobed, fleshy, shortly spurred; lateral lobes erect, subquadrate, incurved, about 3.5 mm long; middle lobe much larger, pandurate, glabrous, retuse at the apex, convex above, auriculate on each side, about 12.5 mm long, 12.5 mm wide, with 4 more or less obscure raised nerves above, at the throat of the spur with two raised papillæ; spur small, compressed, about 4 mm long. Column very short and stout, much swollen laterally at the base. Pollinia 4, unequal, obliquely ellipsoid. Capsules oblong-obovoid, deeply ridged, about 10 cm long, 2.5 cm in diameter.

LUZON, Manila, Bureau of Science orchid house, *Bur. Sci. 80832 Quisumbing,* August 25, 1930. The living plants were originally collected from the forests of Cabuyao, Atimonan, Tayabas Province, growing on trees, similar in habit to *Vanda luzonica* Loher.

The sepals and petals pinard yellow washed and stained half way to the apex and at the base with carmine or nopal red, striations of the same color in the middle. The lateral lobes of the labellum white with purple dots; middle lobe reed yellow, washed with dragon's blood red, the four raised nerves purple, the auricles dotted with pomegranate purple. Column and anther white with purple dots.

The native collectors, because of the habit of the plant, erroneously called it *"Vanda luzonica."*

This magnificent species belongs in the group with *Vanda tricolor* Lindl., but differing in the color of the flowers and in the shape of the labellum, etc. Its closest Philippine relative is *Vanda luzonica* Loher from which it can be distinguished not only by the general habit, but also by the form, size, and color of the flowers. *Vanda truncata* J. J. Sm., from Dutch New Guinea, is apparently a closely allied species, which differs chiefly in the shorter, few-flowered racemes and dissimilar floral markings.

Genus ROBIQUETIA Gaudichaud

ROBIQUETIA PANTHERINA (Kränzl.) Ames. Plates 2, 11, and 27.

Robiquetia pantherina (Kränzl.) AMES, Sched. Orch. 6 (1923) 95, in Merr. Enum. Philip. Fl. Pl. 1 (1925) 435.
Cleisostoma spatulatum BLUME apud Naves Novis. App. (1882) 238.
Saccolabium densiflorum LINDL. in Bot. Reg. 24 (1838) Misc. 56, quoad Philip., non Lindl. in Wall. Cat.; REICHB. f. in Walp. Ann. 6 (1864) 885, quoad Philip.; NAVES, Novis. App. (1882) 241.
Robiquetia spathulata AMES, Orch. 5 (1915) 237, non J. J. Sm.
Saccolabium pantherinum KRÄNZL. in Fedde Repert. 17 (1921) 391.

Stem pendulous, stout, somewhat thickened and compressed, about 32 cm long, 5 to 10 mm in diameter. Leaves coriaceous, oblong, slightly contracted at the sheathing base, unequally and broadly bilobed at the rounded apex, 15 to 18.5 cm long, 4.5 to 5 cm wide. Racemes opposite the leaf bases, elongate, densely flowered, pendulous, simple or one-branched, about 30 cm long including the peduncle; the peduncle stout, about 5.5 cm long, 4 mm in diameter. Flowers odorless, fleshy, 9 to 10 mm across; floral bracts lanceolate, acute, 3 to 7 mm long. Pedicellate ovary puberulent, 6 to 8 mm long. Lateral sepals spreading, broadly and obliquely elliptic-obovate, slightly cucullate or almost flattened, rounded, about 5 mm long, 3 mm wide, the tip slightly bent forward. Dorsal sepal broadly elliptic or oval, rounded, about 4 mm long, 3 mm wide, the tip bent forward, cucullate. Petals spreading, more or less flattened, obovate or obovate-oblong, obtuse, about 3.5 mm long, 2.5 mm wide. Labellum adnate to the column, consisting of an infundibuliform strongly incurved spur which is laterally dilated, and minutely 4-lobulate at the apex, 3-lobed at the mouth; lateral lobes narrow, erect, furnished with a fleshy carinate callus inside near the irregular margins; middle lobe triangular, subacute, fleshy, inflexed, about 3 mm long. There is a well-developed scale ascending obliquely from the anterior wall of the sac and an inconspicuous forcipate scale on the posterior wall. Column stout, very short. Anther acuminate, depressed, long-beaked. Pollinia 2, globose.

LUZON, Manila, Bureau of Science orchid house, *Bur. Sci. 80825 Quisumbing*, September 13, 1930. The living plants were collected from Rizal Province, in the forests, with no definite locality.

The sepals and petals are covered with conspicuous maculations, the background amber yellow mottled and banded with brownish purple. The lateral lobes of the labellum amber yellow

with a circle of brownish purple, the middle lobe amber yellow with two patches of eugenia red at the base, the tip spotted with eugenia red. The spur marguerite yellow.

This species was originally known from the collection of Cuming.[5] It was subsequently discovered by the late C. A. Wenzel, *No. 180,* July 15, 1913, from Dagami, Leyte, in forests 60 meters above sea level. Kränzlin's type of *Saccolabium pantherinum* was collected by Loher, s. n.

As pointed out by Ames,[6] *Robiquetia pantherina* is limited to the Philippine Islands, where it is rare. It "is closely related to *R. spathulata* J. J. Sm.," from which it differs "in having the scale on the anterior wall of the sac obliquely ascending . . . Other differences are found in the contour of the labellum and in the somewhat differently shaped lateral lobes."

Robiquetia pantherina may be recognized among all known Philippine species by the conspicuous maculations on the petals and sepals and by the peculiar form of the labellum, particularly the structure of the spur.

Genus STAUROPSIS Reichenbach f.

STAUROPSIS FASCIATA Benth. Plates 2, 12, 28, and 29.

Stauropsis fasciata BENTH., Gen. Pl. 3 (1883) 572; KRÄNZL. in Xen. Orch. 3 (1894) 132, *t. 275, I 1–7;* VEITCH, Man. Orch. Pl. 2 (1891) Subtribe Sarcantheae 2; Sanders' Orch. Guide (1927) 421.

Trichoglottis fasciata REICHB. f. in Gard. Chron. (1872) 669, L'Orchidophile (1885) 283, fig.; WILLIAMS, Orch. Album 5 (1886) *t. 208,* Orch. Grower's Manual ed. 7 (1894) 732, f.

Staurochilus fasciatus RIDL. in Journ. Linn. Soc. 32 (1896) 351; SCHLECHTER, Die Orchideen (1927) 570.

Vandopsis leytensis AMES, Orch. 5 (1915) 222.

"*Trichoglottis fasciata,* n. sp.

"Bene caulescens, foliis cuneato ligulatis obtuse bilobis abbreviatis (1″ lat. 4″ long.); spicis paucifloris, grandifloris, ovariis pedicellatis trigonis; sepalis petalisque cuneato oblongo acutis, sepalis lateralibus falcatis; labello basi cum columna connato; auriculis baseos dolabratis; lamina antica trifida, laciniis lateralibus triangulis patulis, lacinia media carinaeformi antice oblique obtusata; lineis velutinis ternis in fundos columna utrinque juxta antheram unifalcata; ligula baseos ligulata bidentata velutina nunc erosulo dentata, semper tenuissima." Reichb. f., in Gard. Chron. (1872) 699.

[5] Bot. Reg. 24 (1838) Misc. 56.
[6] Sched. Orch. 6 (1923) 95.

Plant erect or curved, 50 cm or more long. Roots stout, greatly elongated, piercing the leaf sheaths of the lower part of the stem, up to 45 cm long. Stems rigid, about 1 cm in diameter, terete, somewhat flattened toward the apex, concealed by tubular leaf sheaths; internodes 2 to 3.5 cm apart. Leaves distichous, oblong, 9 to 11.5 cm long, 3 to 3.7 cm wide, leathery, thick, flat, spreading, pale yellowish green, equally or unequally bilobed at the broad apex. Racemes rather stout, ascending, 3- or 4-flowered, about 15 cm long including the peduncle, which is 7 cm in length. Flowers large, about 4 cm across, very lax, fleshy, fragrant, lasting for a month or longer. Floral bracts deeply clasping or amplexicaul, triangular-ovate, apiculate, dorsally carinate, 7 to 10 mm long. Pedicellate ovary trigonous, marguerite yellow, about 2 cm long. Lateral sepals elliptic, 2.5 to 2.8 cm long, 1.1 to 1.3 cm wide at the widest portion, subacute, at the very tip with a dorsal horn, which is 4 mm long. Dorsal sepal similar. Petals oblanceolate, 2.3 to 2.5 cm long, 0.8 to 0.9 cm wide, subacute, with a horn at the very tip. Labellum about 1.9 cm long, fleshy, 5-lobed, base deeply concave; the basal lobes broadly rounded, auriculate, bluntly angled in front, erect, about 4 mm long, deeply connate with the sides of the column; middle lobe 3-lobed with lobes at right angles; side lobes triangular-lanceolate, 7 to 8 mm long, subacute, erect-spreading; terminal lobe linear-triangular, strongly compressed laterally and keel-like (when viewed from the side, highest beyond the middle), obtuse, about 9 mm long, 4 mm wide at the base. Disc with several pubescent lines at the base between the basal auricles. Column short and stout, about 8 mm long with a pair of linear or linear-triangular arms at the apex. Ovary semiglobose with a pair of ridges at the tip, densely papillose. Pollinia 4, complanate obovoid.

LUZON, Manila, Bureau of Science orchid house, *Bur. Sci. 80831 Quisumbing*, May 26, 1930. The living plants were epiphytes collected from the forests of Atimonan, Tayabas Province, Luzon. Sepals and petals barium yellow to citron yellow barred with cinnamon brown. The middle lobe of the labellum white, the lateral lobes marguerite yellow and spotted at the base with coral red on top. Gynostemium barium yellow.

While this species was originally described as a member of the genus *Trichoglottis*, it is certainly aberrant from the general conception of that group in its relatively elongate several-flowered inflorescences of large flowers and especially in its spurless labellum.

Like the genus *Vandopsis* Pfitz., this species has an ecalcarate lip with a laterally flattened terminal lobe. But, unlike all members of that genus examined, it possesses conspicuous triangular-lanceolate side lobes.

In this latter feature the present species is in exact accord with the concept of Reichenbach when he transcribed *Trichoglottis philippinensis* Lindl., with its very similar lip structure, into *Stauropsis*. This genus was so-named, of course, from the spreading star-shaped lobes of the lip.

We are, therefore, of the opinion that this species and *Trichoglottis philippinensis* would best be reinstated as members of the genus *Stauropsis* Reichb. f.

Together with its rather localized Philippine occurrence, this species occurs in several parts of eastern tropical Asia; namely, Siam, Lankawi, etc.

This is a rare species in the Philippines, locally known as *"Renanthera alba."* It is characterized by the pale yellowish green oblong leaves, the peculiar labellum, and the horns at the tips of the sepals and petals.

ILLUSTRATIONS

Plate 1

Fig. 1. *Agrostophyllum luzonense* sp. nov., front view of a flower, × 4.
2. *Agrostophyllum luzonense* sp. nov., side view of a flower, × 4.
3. *Dendrobium modestum* Reichb. f., side view of a flower, × 2.
4. *Dendrobium modestum* Reichb. f., front view of a flower, × 2.
5. *Dendrobium batanense* sp. nov., front view of a flower, × 1.
6. *Dendrobium batanense* sp. nov., side view of a flower, × 1.
7. *Spathoglottis plicata* Bl. var. *parsonsii* var. nov., front view of a flower, × 1.
8. *Spathoglottis plicata* Bl. var. *parsonsii* var. nov., side view of a flower, × 1.

Plate 2

Fig. 1. *Dendrobium fairchildae* sp. nov., front view of a flower, × 1.
2. *Dendrobium fairchildae* sp. nov., side view of a flower, × 1.
3. *Dendrobium fairchildae* sp. nov., front view of a flower, × 1.
4. *Stauropsis fasciata* Benth., front view of a flower, × 1.
5. *Stauropsis fasciata* Benth., side view of a flower, × 1.
6. *Robiquetia pantherina* (Kränzl.) Ames, front view of a flower, × 2.
7. *Robiquetia pantherina* (Kränzl.) Ames, side view of a flower, × 2.
8. *Dendrobium junceum* Lindl., front view of a flower, × 1.
9. *Dendrobium junceum* Lindl., side view of a flower, × 1.

Plate 3

Fig. 1. *Renanthera storiei* Reichb. f. var. *philippinensis* var. nov., front view of a flower, × 2.
2. *Renanthera storiei* Reichb. f. var. *philippinensis* var. nov., side view of a flower, × 2.
3. *Bulbophyllum cleistogamum* Ridl., front view of a flower, × 1.
4. *Bulbophyllum cleistogamum* Ridl., side view of a flower, × 1.
5. *Bulbophyllum maquilingense* sp. nov., front view of a flower, × 2.
6. *Bulbophyllum maquilingense* sp. nov., side view of a flower, × 2.
7. *Vanda merrillii* sp. nov., front view of a flower, × 1.
8. *Vanda merrillii* sp. nov., side view of a flower, × 1.

Plate 4

Agrostophyllum luzonense sp. nov.: *1*, apical portion of an inflorescence showing bracts, and side view of the column, × 2; *2*, a bract, × 7.5; *3*, dorsal sepal, × 7.5; *4*, lateral sepal, × 7.5; *5*, petal, × 7.5; *6*, front view of labellum, × 7.5; *7*, side view of labellum,

× 7.5; *8*, side view of column and pedicellate ovary, × 7.5; *9*, front view of column and pedicellate ovary, × 7.5; *10*, view of anther from above, × 18.5; *11*, view of anther from below, × 18.5; *12*, front view of pollinium, × 18.5; *13*, side view of pollinium, × 18.5.

PLATE 5

Dendrobium batanense sp. nov.: *1*, habit of a single plant, × 0.5; *2*, basal portion of a stem showing pseudobulb with three internodes, × 0.5; *3*, dorsal sepal, × 2; *4*, lateral sepal, spur and pedicellate ovary, × 2; *5*, petal, × 2; *6*, front view of labellum, × 2; *7*, front view of column, × 2; *8*, side view of column, pedicellate ovary and bracts, × 2; *9*, view of anther from above, × 7.5; *10*, group of pollinia, × 7.5; *11*, two pollinia, × 7.5; *12*, fruit, × 1.

PLATE 6

Dendrobium modestum Reichb. f.: *1*, habit, about one-third natural size; *2*, dorsal sepal, × 4; *3*, lateral sepal, × 4; *4*, lateral sepal and spur, × 4; *5*, petal, × 4; *6*, front view of labellum, × 4; *7*, side view of labellum, × 4; *8*, side view of column, × 4; *9*, front view of column, × 4; *10*, view of anther from below, × 10; *11*, side view of anther, × 10; *12*, pollinia, × 10.

PLATE 7

FIG. 1. *Dendrobium fairchildae* sp. nov.: *1*, dorsal sepal, × 1; *2*, exterior view of one lateral sepal and spur and partial view of the other lateral sepal, and the pedicellate ovary, × 1; *3*, interior view of a lateral sepal, spur and side view of the column and pedicellate ovary, ×1; *4*, petal, × 1; *5*, front view of (flattened) labellum, × 1; *6*, side view of labellum (natural position), × 1; *7*, front view of column, × 1; *8*, view of anther from above, × 6; *9*, view of anther from below, × 6; *10*, front view of pollinium, × 6; *11*, side view of two pollinia, × 6.

2. *Renanthera storiei* Reichb. f. var. *philippinensis* var. nov.: *12*, dorsal sepal, × 2; *13*, lateral sepal, × 2; *14*, petal, × 2; *15*, view of labellum and column from above, × 7.5; *16*, side view of labellum and column, × 7.5; *17*, front view of column, × 7.5; *18*, view of anther from below × 7.5; *19*, front and side views of pollinia, × 7.5.

PLATE 8

Dendrobium junceum Lindl.: *1*, dorsal sepal, × 2; *2*, lateral sepal, × 2; *3*, lateral sepal and spur, × 2; *4*, petal, × 2; *5*, front view of labellum, × 2; *6*, side view of labellum, × 2; *7*, front view of column, × 2; *8*, side view of column, × 2; *9*, view of anther from above, × 6; *10*, view of anther from below, × 6.

PLATE 9

Bulbophyllum cleistogamum Ridl.: *1*, tip of the inflorescence showing bracts, × 2; *2*, dorsal sepal, × 2; *3*, lateral sepal, × 2; *4*, petal,

× 18; *5*, side view of column, labellum and pedicellate ovary, × 2; *6*, front view of labellum and column, × 2; *7*, apical region of the column, × 4; *8*, view of anther from above, × 10; *9*, view of anther from below, × 10.

PLATE 10

Bulbophyllum maquilingense sp. nov.: *1*, habit, approximately × 2; *2*, view of dorsal sepal from back, × 4; *3*, side view of dorsal sepal, × 4; *4*, outer view of lateral sepal, × 4; *5*, inner view of lateral sepal, × 4; *6*, outer view of petal, × 4; *7*, inner view of petal, × 4; *8*, front view of labellum, × 4; *9*, side view of labellum, column and pedicellate ovary, × 4; *10*, front view of column, × 18.

PLATE 11

FIG. 1. *Vanda merrillii* sp. nov.: *1*, dorsal sepal (natural position), × 1; *2*, lateral sepal (natural position), × 1; *3*, petal (natural position), × 1; *4*, front view of labellum, × 2; *5*, side view of labellum, column and anther, × 2; *6*, view of column from above, × 3.65; *7*, view of anther from above, × 3.65; *8*, view of anther with pollinia, from below, × 3.65; *9*, pollinia, × 8; *10*, fruit, × 0.5.

2. *Robiquetia pantherina* (Kränzl.) Ames: *11*, side view of dorsal sepal, × 3; *12*, front view of dorsal sepal, × 3; *13*, petal, × 3; *14*, lateral sepal, × 3; *15*, side view of column, anther, labellum and spur, × 4.25; *16*, view from above of column, anther and labellum, × 4; *17*, back view of spur, × 3.5; *18*, longitudinal section of labellum and spur showing prominent scale on the anterior wall, × 3.5; *19*, median section of spur showing partition, × 3; *20*, view of anther from below, × 3; *21*, pollinia, × 3.

PLATE 12

Stauropsis fasciata Benth.: *1*, interior view of dorsal sepal, × 2; *2*, side view of dorsal sepal, × 2; *3*, interior view of lateral sepal, × 2; *4*, interior view of petal, × 2; *5*, view of labellum and column from above, × 4; *6*, side view of labellum and column, × 4; *7*, side view of anther, × 4; *8*, view of anther from above, × 4; *9*, view of anther from below, × 4; *10*, front view of pollinium, × 15; *11*, side view of pollinium, × 15.

PLATE 13

Agrostophyllum luzonense sp. nov.; habit, much reduced.

PLATE 14

Agrostophyllum luzonense sp. nov.; tops of three flowering stems, approximately natural size.

PLATE 15

Spathoglottis plicata Bl. var. *parsonsii* var. nov.; habit, much reduced.

PLATE 16

Dendrobium batanense sp. nov.; habit, much reduced.

PLATE 17

FIG. 1. *Spathoglottis plicata* Bl. var. *parsonsii* var. nov.; flowers, very slightly reduced.
2. *Dendrobium batanense* sp. nov.; flowers, reduced.

PLATE 18

Dendrobium fairchildae sp. nov.; habit, very much reduced.

PLATE 19

Dendrobium fairchildae sp. nov.; inflorescence, approximately one-half natural size.

PLATE 20

FIG. 1. *Dendrobium junceum* Lindl.; habit, very much reduced.
2. *Dendrobium junceum* Lindl.; flowers, slightly reduced.

PLATE 21

Dendrobium junceum Lindl.; tops of flowering stems, very much reduced.

PLATE 22

Dendrobium modestum Reichb.f.; habit, very much reduced.

PLATE 23

FIG. 1. *Bulbophyllum cleistogamum* Ridl.; flower and old fruit capsule. approximately natural size.
2. *Bulbophyllum cleistogamum* Ridl.; habit, very much reduced.

PLATE 24

FIG. 1. *Renanthera storiei* Reichb.f. var. *philippinensis* var. nov.; habit, very much reduced.
2. *Renanthera storiei* Reichb.f. var. *philippinensis* var. nov.; inflorescence, reduced.

PLATE 25

Vanda merrillii sp. nov.; habit, very much reduced.

PLATE 26

Vanda merrillii sp. nov.; inflorescence, slightly reduced.

PLATE 27

FIG. 1. *Robiquetia pantherina* (Kränzl.) Ames; habit, very much reduced.
2. *Robiquetia pantherina* (Kränzl.) Ames; flowers, approximately natural size.

PLATE 28

Stauropsis fasciata Benth.; habit, very much reduced.

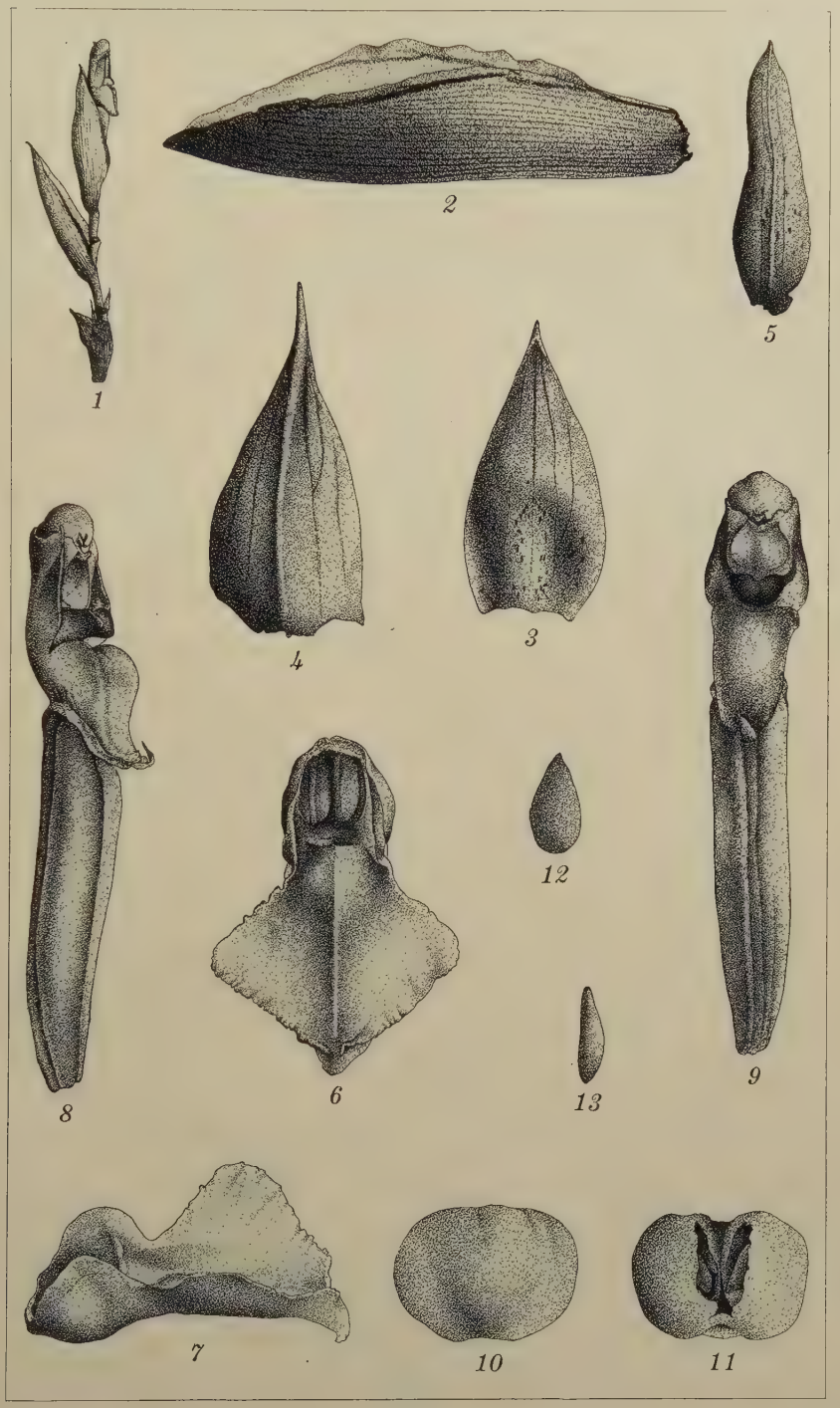
PLATE 29

Stauropsis fasciata Benth.; flower, slightly enlarged.

PLATE 1.

PLATE 2.

PLATE 3.



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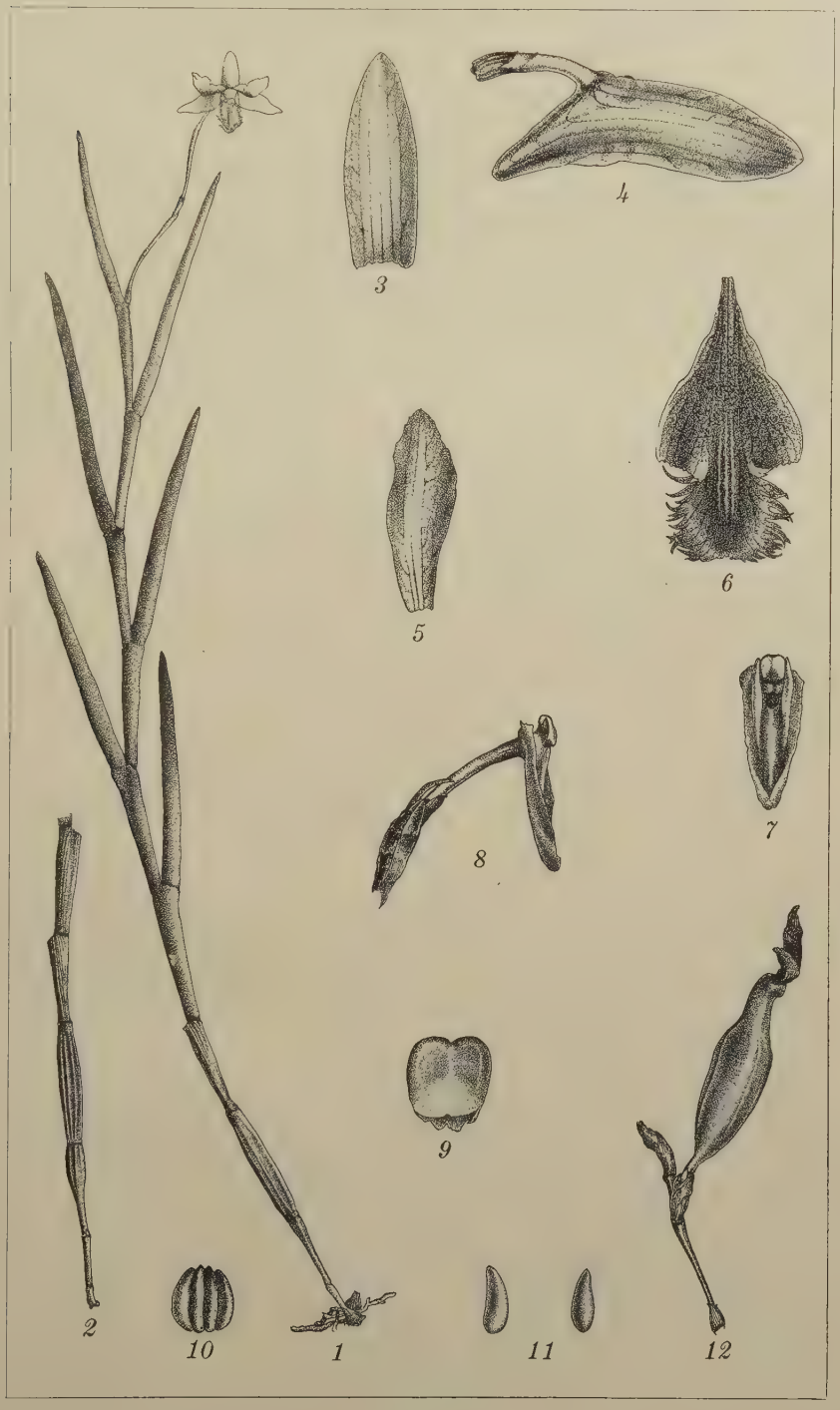

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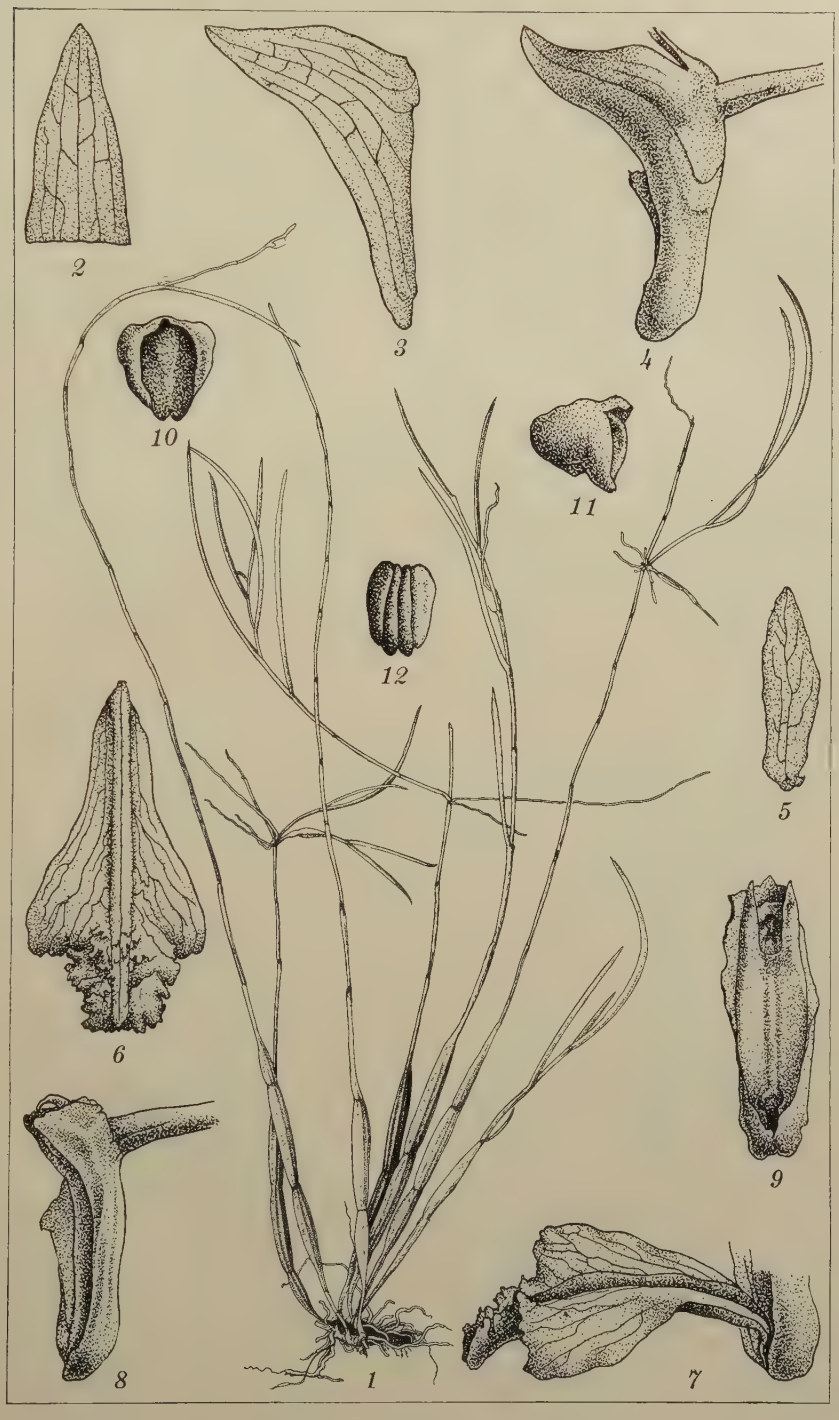

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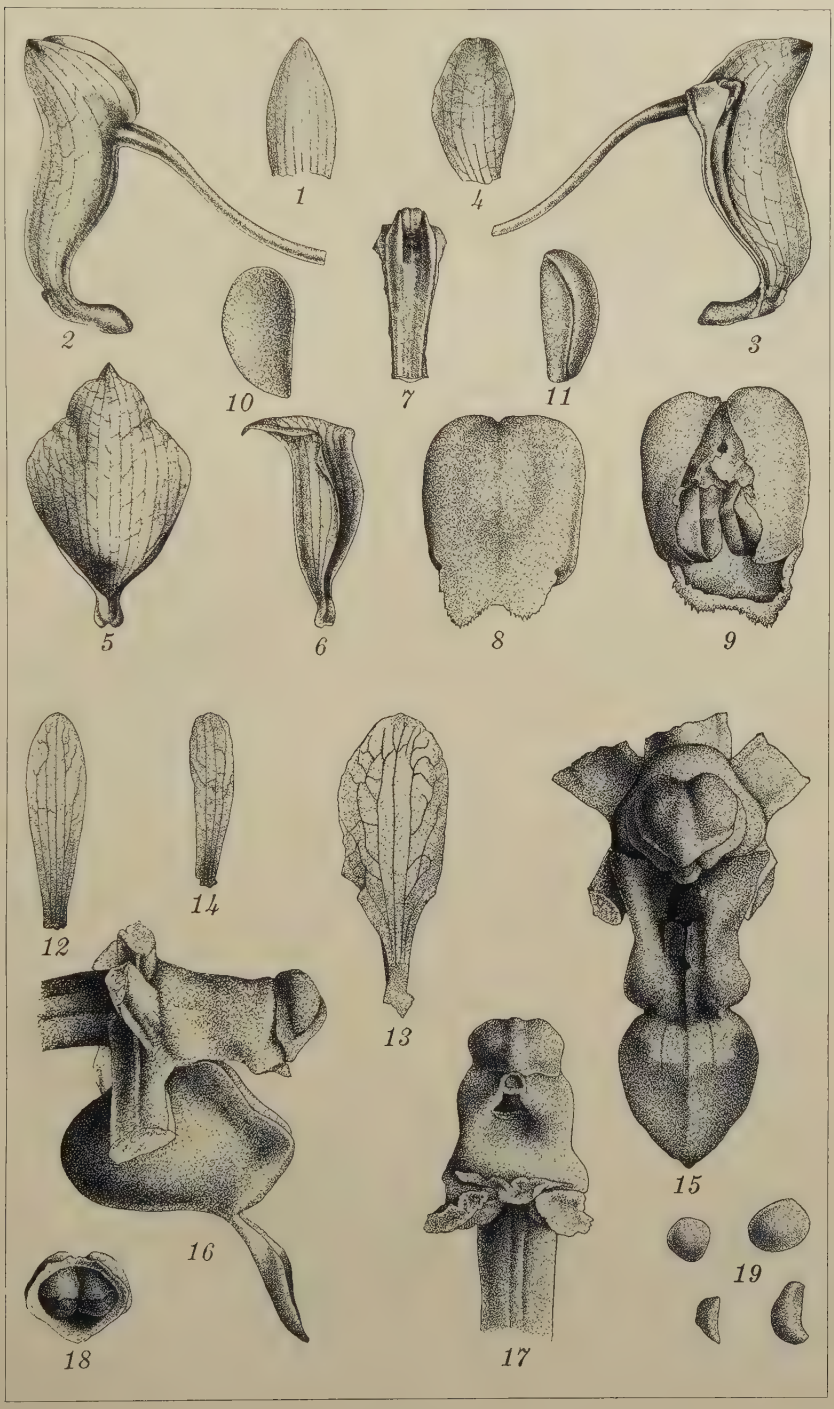

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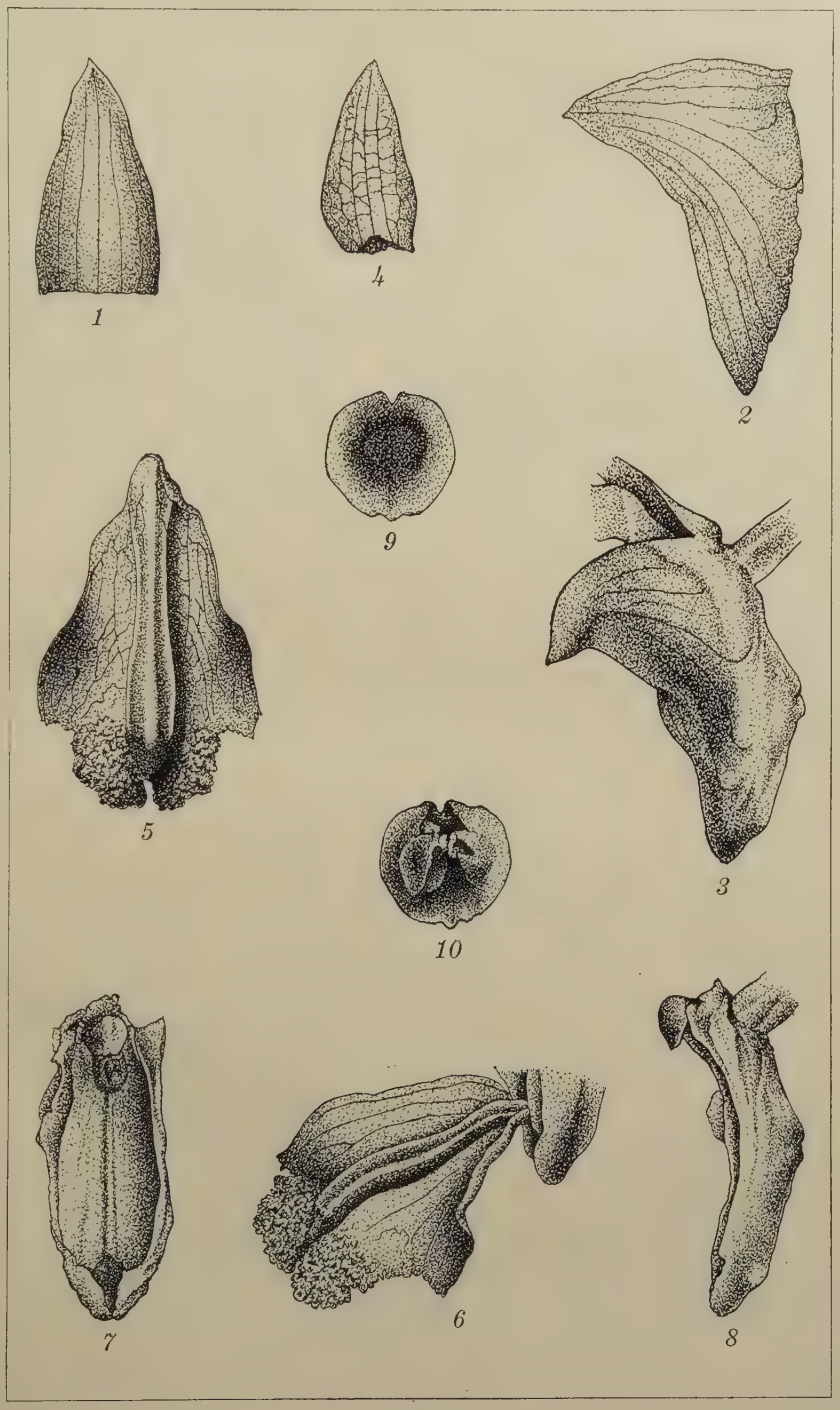

PLATE 8.

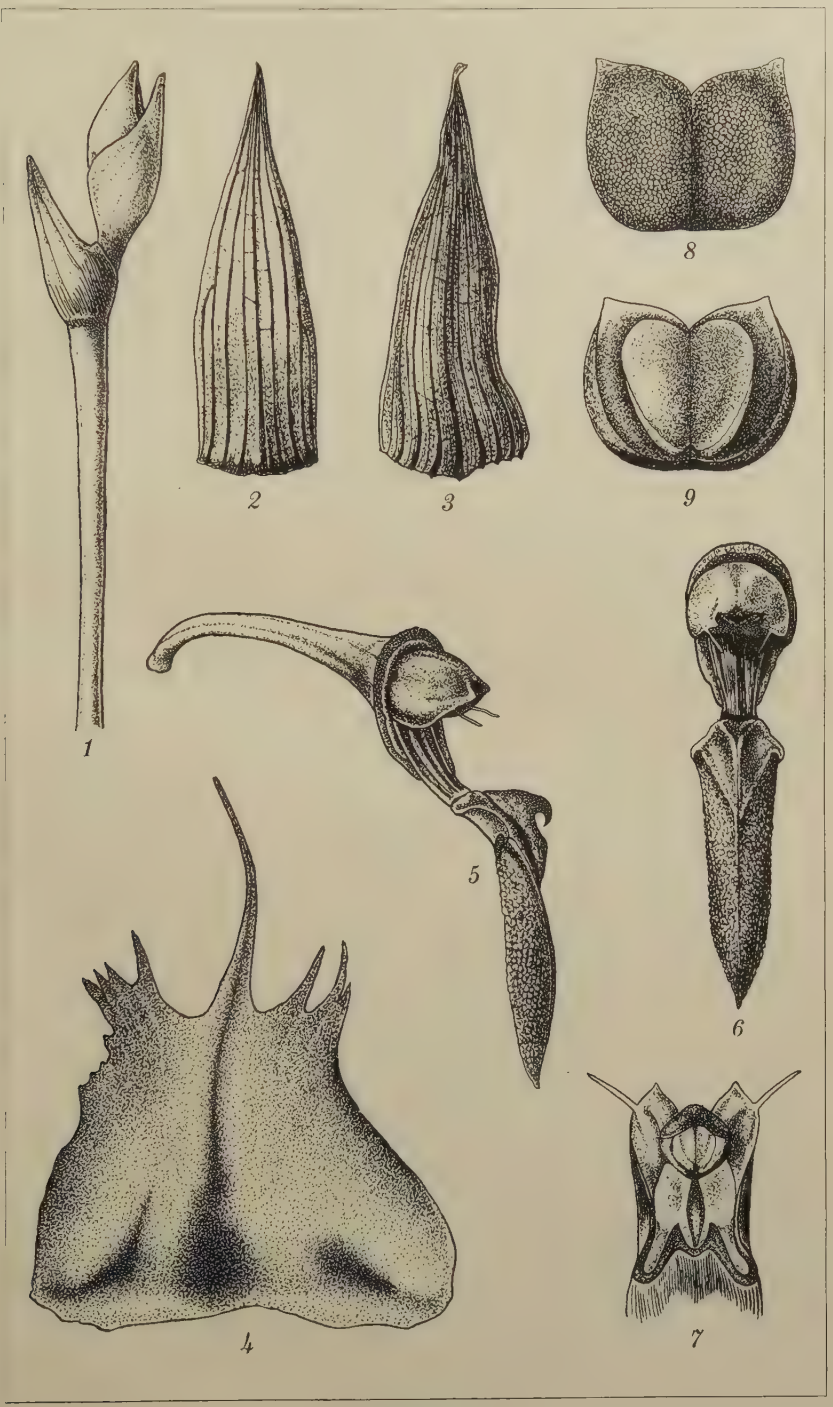

PLATE 9.

PLATE 10.

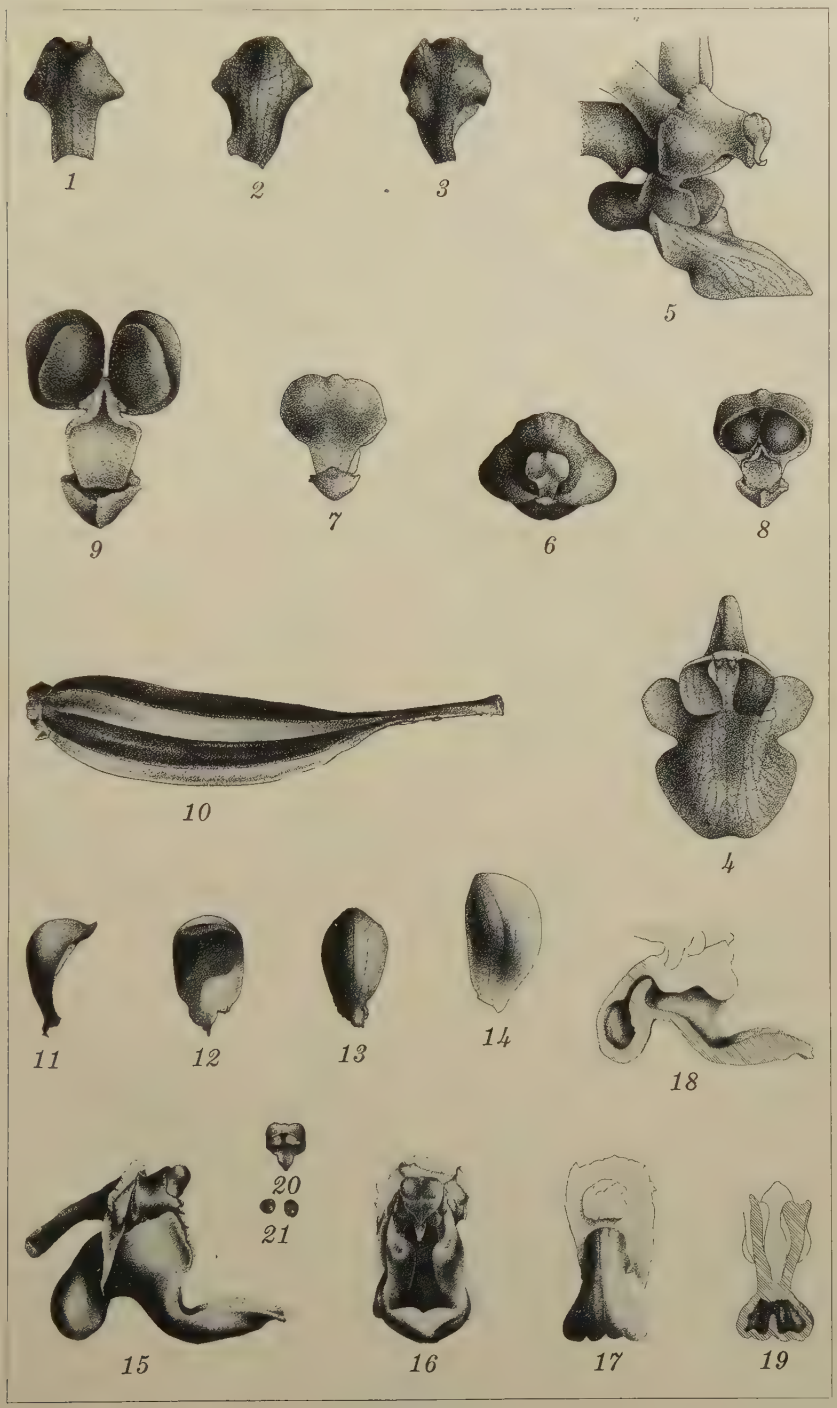

PLATE 11.

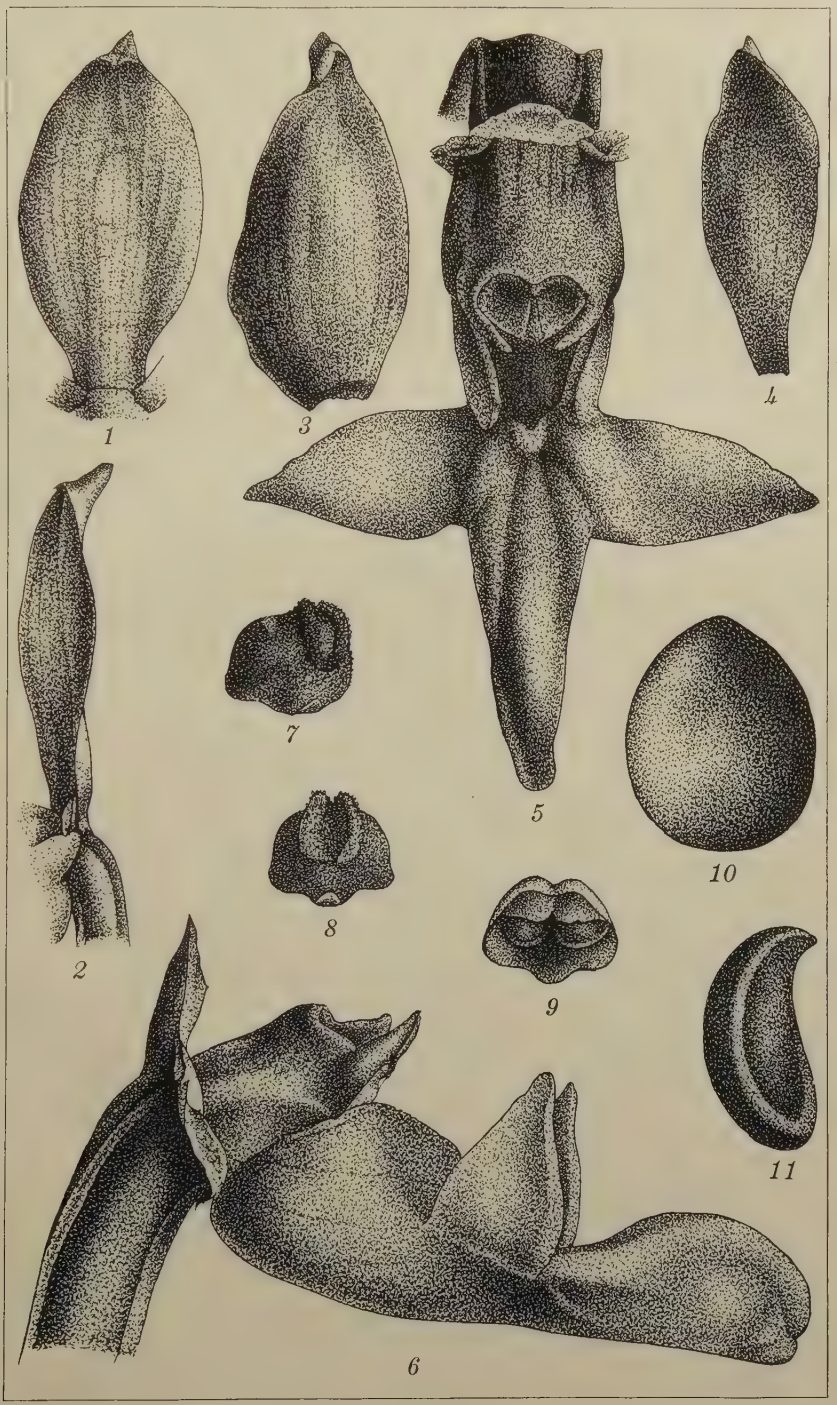

PLATE 12.

PLATE 13.

PLATE 14.

PLATE 15.

PLATE 16.

PLATE 17.

PLATE 18.

PLATE 19.

PLATE 20.

PLATE 21.

PLATE 22.

PLATE 23.

PLATE 24.

PLATE 25.

PLATE 26.

PLATE 27.

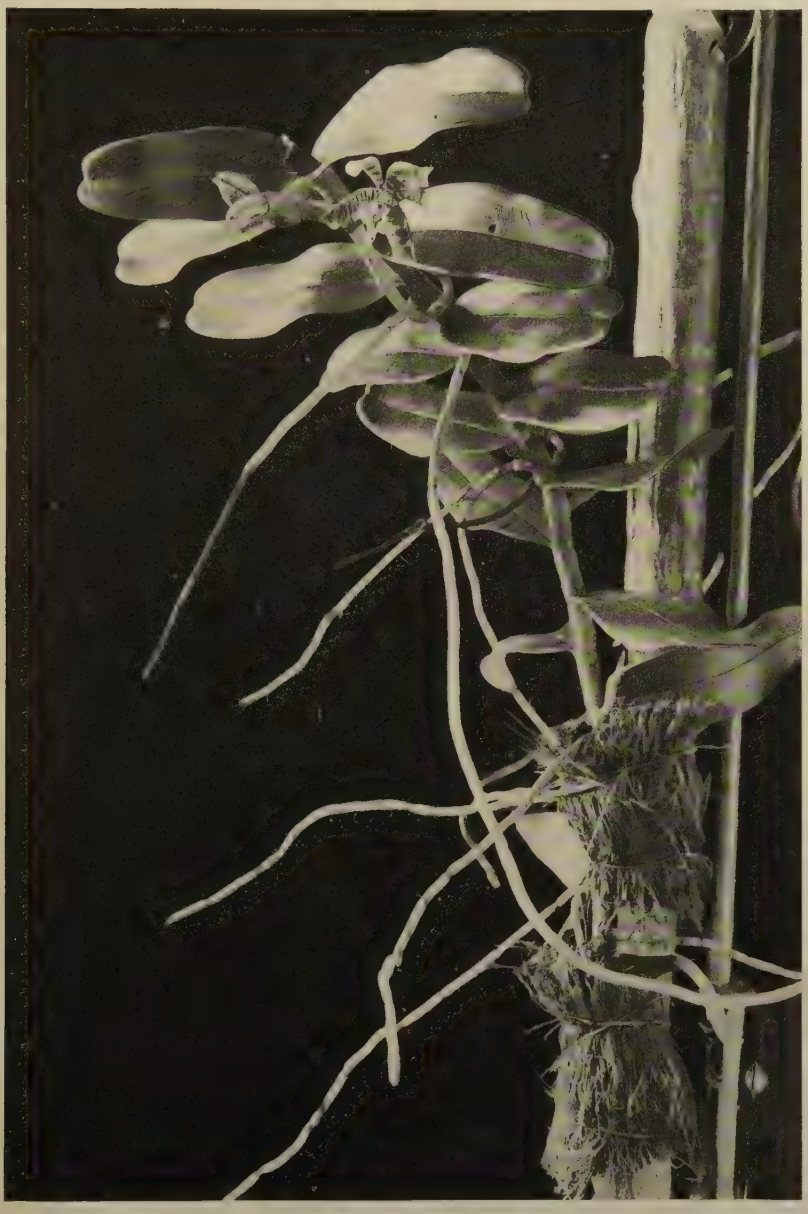

PLATE 28.

PLATE 29.

MUTATION STUDIES ON PHILIPPINE WILD DROSOPHILA

By Leopoldo S. Clemente

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THREE PLATES

ABSTRACT

Mutation studies were made on two forms of Philippine wild *Drosophila;* one is "banded," due to the presence in both sexes of prominent black bands at the abdominal region, and the other is "bandless," due to the absence in both sexes of such abdominal bands. Numerous mutations were observed from the bandless form, but none from the banded. Autosomal as well as sex-linked mutations were found, although most of them are of the former type. The different mutations reported in this paper in the order of their discovery are "rose-eye," which is a sex-linked recessive to red-eye; "vestigial wing," which is an autosomal recessive to long wing; "eyeless," which is an autosomal recessive to an eyed condition; and "purple-eye," which is an autosomal recessive to red-eye. The first two mutations originated from the bandless Cebu wild *Drosophila,* while the last two from the bandless Manila wild *Drosophila.* Conclusive evidence was found to show that the banded and bandless forms are of different species; they appear different externally, one mutates while the other does not, and the two do not cross.

INTRODUCTION

This work on Philippine wild *Drosophila* has for its purpose primarily to produce mutant strains for use in our course in zoölogy to demonstrate Mendelian principles, and secondarily to work out the genetics of this Philippine form. No mutation in Philippine *Drosophila* has been reported, although various attempts have been made to produce mutations, especially by Dr. P. B. Sivickis, of the Department of Zoölogy, University of the Philippines, and by Dr. N. B. Mendiola, of the College of Agriculture, Los Baños.

My first attempt along this line was made while I was connected with the Junior College at Cebu, Cebu Island. Wild flies collected there January 15, 1924, furnished the material for this series. In June, 1925, when I was transferred to Manila, the Cebu wild stocks and mutants were brought with me and the experiments were continued. Unfortunately, the wild stocks as well as the mutants died in the summer of 1926. The days became so hot during that summer that all efforts to save the flies failed. Luckily, the mode of inheritance of the mutants had been worked out before they died. A second attempt to continue the experiment was made June 1, 1926, when a new stock of wild flies was collected in Manila, Luzon Island.

While it is true that work of this nature on *Drosophila* has been done exhaustively by many investigators, especially by Morgan and his associates (1919) on *D. melanogaster*, by Lancefield (1922) on *D. obscura*, by Metz (1914) on *D. willistoni*, by Metz (1916) on *D. virilis*, and by Sturtevant (1921) on *D. simulans*, yet, considering the fact that the experimental materials used here are different, being Philippine forms, a repetition of similar work is still justifiable.

The results reported in this paper were those that I accumulated while I was in the Junior College at Cebu and also those that I and my students in genetics at Manila were able to obtain. All the illustrations were drawn by the artist of the Department of Zoölogy, Mr. Rafael A. Dayao.

MATERIALS AND METHODS

Two distinct forms of wild *Drosophila*,[1] "banded" and "bandless," that were collected from Cebu and Manila were used. There are thus "banded Cebu wild" as well as "banded Manila wild" and "bandless Cebu wild" as well as "bandless Manila wild." The "banded" form (Plate 1, figs. 1 and 2) is so-called because both the males and females are well-provided with prominent black bands on the abdominal region, similar to *D. melanogaster*. This black marking is especially well-developed in the male, where the entire caudal end of the abdomen is colored solid black. This difference in the color markings of the male and female of the banded form makes the sexing very easy. In addition to the above difference, there is a row of prominent spines or a comb at the inner surface of the distal end of the

[1] The species is undetermined; however, samples of the flies were sent to Dr. A. H. Sturtevant, California Institute of Technology, Pasadena, California, for identification.

first tarsal segment of the male (Plate 1, fig. 6), while the female has none. This comb arrangement is exactly the same as in *D. melanogaster*. Both sexes of the banded form have a dark gray body, long wings, and red eyes.

The bandless form (Plate 1, figs. 3 and 4) has only a faint pigmentation at the junction of the abdominal segments in males and females, thus sexing of this form is rather difficult. The surest way to distinguish the male from the female in this form, in addition to differences in body size, shape of the abdomen, etc., is to look for a group of peglike bristles at the caudoventral end of the abdomen. This is absent in the female. Unlike the banded form, there is a complete absence of comb even in the proleg of the male (Plate 1, fig. 5). Both sexes of this form have a light gray body, long wings, and red eyes (Plate 2, fig. 1).

The banded and the bandless forms of *Drosophila* are invariably found together in the wild state, but the banded individuals are more numerous and more obtainable most of the time. The banded flies are more hardy than the bandless for they can breed in places where the latter would die out. They are more active, more prolific, and live longer than the bandless.

The laboratory food provided for them consisted of sliced ripe banana sprinkled with yeast foam tablets to hasten fermentation. The mixture is stirred until it is of a jellylike consistency. Food that is freshly prepared is found satisfactory, although food a day old is still usable, especially if kept in a cool place. Neither the food nor the containers are sterilized. The containers are washed in ordinary tap water, although in the presence of mold, boiling water is sometimes used.

Both 8-drachm vials and 120–cubic centimeter bottles were utilized for breeding containers; vials for test matings, and the bottles for culture stocks. Inside they were provided with a double fold of towel paper for the attachment of pupæ and for absorption of excess moisture. The plug used is kapok, a cheap cotton that is always available in Manila.

When the experiment was started, the flies were reared under laboratory conditions except that in summer they were kept in the ice box. Later, a frigidaire was installed in our laboratory to take the place of the ice box, which was found inadequate because the temperature could not be controlled. The frigidaire was kept running day and night at 25° C., although a slight fluctuation in temperature was noted in different chambers. The flies thrived so well in the frigidaire that they are now

being kept there throughout the year. The electrical current used is so little that it is almost negligible.

RESULTS

So far, no mutation of any kind has been observed from the banded form whether collected in Cebu or in Manila. On the other hand, both the Cebu and Manila bandless readily gave rise to mutations. What causes such a difference in their mutability is very hard to explain. It could not be due to the method used, for the two forms were subjected to the same treatment. It is probable that the banded and bandless are of different species and as such have a different germinal stability. That the two are of different species is proven by the fact that they would not cross. This is true whether the mating is between the Cebu forms or between the Manila forms. In addition to their failure to cross, the banded and bandless differ in many other respects that would place them under separate species. The banded is more viable, more prolific, more active, and lives longer than the bandless. The male of the banded is provided with a comb at the inner surface of the distal end of the first tarsal segment, while the male of the bandless has none (Plate 1, figs. 5 and 6).

Only the bandless form will be discussed thoroughly in as much as this is the one that gave rise to mutations. It cannot be stated for sure at present whether or not the Cebu and Manila bandless are of the same species, but it is most likely that they are for they and their mutants cross and produce fertile offspring. Moreover, their external appearances are exactly the same and the males of both do not possess a comb at the proleg. These forms are doubtless different from *Drosophila melanogaster* used by Morgan.

MUTANTS FROM THE BANDLESS CEBU WILD

The mutations that have their origin from the bandless Cebu wild are rose-eye, which was found to be sex-linked, and vestigial wing, which was found to be autosomal. There were several other variations observed from this stock but they did not breed true, due perhaps to the fact that they are somatic variations only, and therefore are not hereditary. Several variations found might be heritable, but due to their weakness and the fact that they are represented by one or two individuals only, their genetic behavior could not be studied.

THE "ROSE-EYE" MUTATION

After about four months of mass mating the bandless Cebu wild fly, there was observed for the first time May 8, 1924, a male fly with light red eyes to which was given the name "rose." A few days later more rose males were found, but no females. The absence of females among the first mutants suggests right away that this mutation is sex-linked. Morgan (1910) found similar phenomenon when he discovered the white-eye, a sex-linked mutation in *Drosophila melanogaster.* Whether or not this eye mutation is the same as the eosin or vermilion of Morgan (1911, 1912) or cherry of Safir (1913) could not definitely be ascertained, for no other sex-linked character was discovered to establish its true identity. However, I believe that it is not eosin, because rose is darker in shade and there is practically no difference in the eye color of male and female, nor of the homozygous and heterozygous individuals as in the case of eosin (Morgan and Bridges, 1916). It is not vermilion, because this rose mutation is lighter in shade than vermilion. It is probable that this is identical with cherry.

Rose-eye (Plate 2, fig. 2) is very noticeable among individuals that have just emerged from the pupal cases. The color changes to a darker shade as the fly grows older, but it never becomes as dark as the red-eye of the wild. The typical dark spot that is present at the center of the red-eye is absent in rose-eye. To insure proper classification, the flies should be examined when young, about a day or two after emerging from the pupal cases, otherwise some difficulties may be encountered. One who is experienced, however, will have no difficulty in distinguishing the rose from the wild no matter how old the flies may become. Rose flies in their pupal stage can be detected from the wild in having very light rose eyes, which can be seen through the transparent pupal cases.

So far as could be detected, rose mutation affects the eye color only, and as the breeding results show, there seems to be little effect upon the viability of the individual carrying the mutation.

In order to study the genetic behavior of the rose mutation, two types of mating were made with the wild. Rose females were mated with wild males and their reciprocal cross. Both types of matings were carried to the F_2 generation. Several series were made of each cross to insure proper results.

Table 1 shows the F_1 obtained by mating rose females with wild or red males. It will be noted that all females are red-eyed while all the males are rose-eyed. In a total of 11,022 F_1 flies, there are 5,678 of the former to 5,324 of the latter. This is exactly what would be expected if rose-eye is a sex-linked character and recessive to its allelomorph red-eye.

The F_1 of the above cross were mated together en masse and the result is shown in Table 2. There are in the F_2 both red and rose females as well as red and rose males in about equal numbers as would be expected. In a total of 18,859 F_2 flies, there are 4,886 red-eyed females, 4,883 rose-eyed females, 4,559 red-eyed males, and 4,531 rose-eyed males.

TABLE 1.—*F_1 obtained by mating rose-eyed females with red-eyed males.*

Series.	Red females.	Rose males.
1	343	232
2	756	670
3	266	266
4	134	133
5	719	721
6	678	692
7	1,566	1,396
8	169	179
9	523	531
10	524	504
Total	5,678	5,324

TABLE 2.—*F_2 obtained by mating together the F_1 red females and rose males.*

Series.	Females.		Males.	
	Red.	Rose.	Red.	Rose.
1	531	483	287	300
2	1,031	1,020	1,012	1,006
3	90	145	86	85
4	73	76	66	68
5	288	290	291	286
6	328	256	301	270
7	1,897	1,949	1,929	1,868
8	115	130	113	134
9	175	195	161	185
10	355	339	313	329
Total	4,886	4,883	4,559	4,531

A reciprocal cross was made by mating red-eyed females with rose-eyed males. As may be seen in Table 3, all the F_1 flies,

whether males or females, are red-eyed. In a total of 3,868 F_1 flies, 1,960 are males and 1,908 are females. The F_1 were mated inter se so as to produce F_2, and the result is shown in Table 4. All the F_2 females are red-eyed while the males are of two kinds, one half are red-eyed and the other half are rose-eyed. In a total of 1,784 F_2 flies, there are 841 red females, 469 red males, and 474 rose males.

The results in these two reciprocal crosses clearly indicate that "rose-eye" is a sex-linked character recessive to "red-eye."

TABLE 3.—*F_1 obtained by mating red-eyed females with rose-eyed males.*

Series.	Red females.	Red males.
1	613	615
2	108	102
3	198	215
4	147	159
5	146	127
6	134	112
7	97	92
8	120	90
9	259	274
10	28	20
11	110	102
Total	1,960	1,908

TABLE 4.—*F_2 obtained by mating together the F_1 red females and red males.*

Series.	Red females.	Males.	
		Red.	Rose.
1	239	143	123
2	32	18	14
3	270	150	169
4	27	10	22
5	60	37	29
6	31	12	21
7	63	32	27
8	119	67	69
Total	841	469	474

THE "VESTIGIAL WING" MUTATION

This is the second mutation that appeared from the bandless Cebu wild flies. It was first reported by Miss C. Antonio, September 23, 1925, and a few days later by Miss N. Castro. That the same mutation was discovered simultaneously by these two

students is explained by the fact that the Cebu wild stock they used came from the same source. When it first appeared it was called "wingless," but later it was changed to "vestigial wing" because it resembles the one described by Morgan (1919) under the same term. The wings are very much reduced and appear like a mere vestige in most individuals, although longer in others. In no case, however, were individuals found with wings that are even half as long as the normal. The balancers are also much reduced in length, the terminal segment suffering the greatest reduction (Plate 3, fig. 1).

The genetic behavior of vestigial wing was studied by mating with the wild form. Table 5 gives the results obtained in the F_1 and F_2 of the two reciprocal crosses. As may be noted, the F_1 are normal-winged in both crosses, thus showing that vestigial is an autosomal recessive to normal wing. The F_2 in both reciprocal crosses gives the typical Mendelian ratio irrespective of sex. In a total of 1,438 F_2 flies, there are 1,079 normal-winged to 359 vestigial winged or a ratio that is very close to 3:1.

TABLE 5.—*F_1 and F_2 obtained in both reciprocal crosses involving vestigial and normal wing.*

Type of mating.	F_1 normal.		F_2.	
	Female.	Male.	Normal.	Vestigial.
Normal ♀ × vestigial ♂	23	21	651	207
Vestigial ♀ × normal ♂	42	47	428	152
Total	65	68	1,079	359

MUTATIONS FROM THE BANDLESS MANILA WILD

The mutations that were found from the bandless Manila wild are "eyeless" and "purple-eyed." Both of these behave as simple Mendelian mutations recessive to their normal allelomorphs. There are other mutations that owe their origin to the bandless Manila wild, but these will be reported later in another paper because their exact genetic behavior is still being studied.

THE "EYELESS" MUTATION

This mutation was first observed in the bandless Manila wild June 22, 1926. The first flies found were of both sexes and were thought to be "white-eyed," but on closer examination proved to be "eyeless." This same mutation was also reported by Morgan (1914) as a fourth chromosome mutation.

The eyeless individual has a very small head due to the failure of the ommatidia to develop. Likewise, the ocelli are absent. The area that used to be occupied by the ommatidia is very much roughened with irregularly scattered hairs and bristles. There is, however, a great variation in the manifestations of this eyeless mutation. Most of the individuals are totally eyeless (Plate 3, fig. 2), but there are those that possess small eyes on the right side only and none on the left side (Plate 3, fig. 4); those with small eyes on the left side only and none on the right side (Plate 3, fig. 3); and those with small eyes on both sides (Plate 4, fig. 1). These small eyes when present are mostly sessiled or flat on the head, but there are cases where the eyes are much elevated giving them a stalked appearance (Plate 4, figs. 2 and 3). Several flies were found that possessed two small eyes on one side and only one on the other side (Plate 4, fig. 4). The eyes whenever present vary from microscopic proportions to a size that could easily be detected without the use of a lens. Some have their eyes anteriorly placed, while others have their eyes at the posterior margin of the head. In case eyes are present on both sides, they are rarely equal in size, shape, and position.

Eyeless individuals are the most numerous, the next are the right-eyed, then follows the left-eyed, and the least numerous are those with eyes on both sides. The difference in number between right- and left-eyed is so small that they can be considered equal. In a total of 3,114 flies, 2,507 are totally eyeless, 283 are right-eyed, 267 are left-eyed, and 57 have eyes on both sides. This gives 80.51 per cent, 9.09 per cent, 8.58 per cent, and 1.82 per cent, respectively (See Table 6).

TABLE 6.—*Count of the eyeless stock showing the number and percentage of different eye variations.*

	Eyeless.	Right-eyed.	Left-eyed.	Two-eyed.	Total.
Number	2,507	283	267	57	3,114
Percentage	80.51	9.09	8.58	1.82	100

Count of the eyeless stock also shows that the actual number as well as the percentage of eyed forms is higher in females than in males. This is true in the right-eyed, left-eyed, or two-eyed (see Table 7). Among the females there are 11.22 per cent right-eyed, 10.08 per cent left-eyed, and 2.44 per cent two-eyed,

while among the males there are 6.54 per cent right-eyed, 6.82 per cent left-eyed, and 1.11 per cent two-eyed, respectively.

TABLE 7.—*Showing the relative number and percentage of the different forms of eyeless in males and females.*

Forms of eyes.	Females.		Males.	
	Number.	Per-centage.	Number.	Per-centage.
Eyeless	1,277	76.19	1,230	85.53
Right-eyed	189	11.22	94	6.54
Left-eyed	169	10.08	98	6.82
Two-eyed	41	2.44	16	1.11
Total	1,676	100.00	1,438	100.00

According to our unpublished results these different variations exhibited by the eyeless stock are not hereditary. They are probably somatic variations in the manifestation of the eyeless gene.

Crosses of the eyeless with normal eyed invariably give F_1 that are normal eyed, showing that it is recessive to normal eye. This is true in both reciprocal crosses. The F_1 when mated together give eyeless and normal-eyed flies in the ordinary simple Mendelian fashion as shown in Table 8. In a total of 7,896 F_2 flies obtained in both reciprocal crosses 5,951 are normal-eyed and 1,945 are eyeless, representing a ratio of 3 of the former to 1 of the latter.

TABLE 8.—*F_1 and F_2 obtained in both reciprocal crosses involving eyeless and eyed.*

Type of mating.	F_1 eyed.		F_2.	
	Female.	Male.	Red.	Purple.
Eyeless ♀ × eyed ♂	1,241	1,123	2,803	918
Eyeless ♂ × eyed ♀	1,347	1,203	3,148	1,027
Total	2,588	2,326	5,951	1,945

"PURPLE-EYE" MUTATION

This mutation appeared twice in the bandless Manila wild stock. The first appearance was noted July 7, 1925, among a batch of old flies. Due to the brownish tinge of the eyes of these flies, they were temporarily called "brown-eyed." No pure culture was produced when they first appeared for they died

shortly after they were found. The second time this mutation appeared was August 26, 1926. A pure culture was raised at this time and it was noted that the change in the eye color as the flies grew older was similar to the "purple" of Morgan (1919). For this reason the name was changed from brown to purple. When the flies newly emerge from the pupal cases the color of the eyes is very light purple (Plate 2, fig. 3), and this turns darker until on the third or fourth day the color is very dark purple with a brownish tinge (Plate 2, fig. 5). This is especially true in very old flies. The true purple shade is exhibited by flies that are about a day or two old (Plate 2, fig. 4).

Genetic tests of "purple-eye" show that it is an autosomal mutation recessive to "red-eye." Table 9 shows the result of the two reciprocal crosses. The F_1 are all red-eyed while the F_2 are of two kinds, red-eyed and purple-eyed. Among 9,938 F_2 flies in both crosses, there are 7,368 red-eyed to 2,570 purple-eyed or a ratio that is close to 3:1.

TABLE 9.—*F_1 and F_2 obtained in both reciprocal crosses involving purple and red.*

Type of mating.	F_1 red.		F_2.	
	Female.	Male.	Red.	Purple.
Purple ♀ × red ♂	1,920	1,710	4,296	1,540
Red ♀ × purple ♂	1,300	1,218	3,072	1,030
Total	3,220	2,928	7,368	2,570

CONCLUSIONS

1. Of the two Philippine forms used in this experiment, the bandless gives rise to mutations while the banded does not.

2. The bandless and banded are undoubtedly of two different species for they do not cross and have a different external appearance.

3. The bandless Cebu and Manila wild may be of the same species for they look alike and they and their mutants produce fertile offspring when crossed.

4. Most of the mutations found are autosomal for out of the four reported, three are autosomal and only one is sex-linked.

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ILLUSTRATIONS

PLATE 1

FIG. 1. Banded wild male.
2. Banded wild female.
3. Bandless wild male.
4. Bandless wild female.
5. Left proleg of the bandless wild male showing the complete absence of comb.
6. Right proleg of the banded wild male showing the presence of comb.

PLATE 2

FIG. 1. Wild fly showing the red eye color.
2. Rose mutant.
3. Young purple just emerged from the pupal case.
4. Medium purple about a day or two old.
5. Old purple about four days old.

PLATE 3

FIG. 1. Vestigial mutant with wings almost completely gone.
2. Totally eyeless.
3. Right-eyed variation of eyeless mutation.
4. Left-eyed variation of eyeless mutation.
5. Two-eyed variation of eyeless mutation.
6. Right-eyed, but the eye is stalked.
7. Two-eyed, but the eyes are stalked.
8. Three-eyed; two of the eyes are on the left side and one is on the right side.

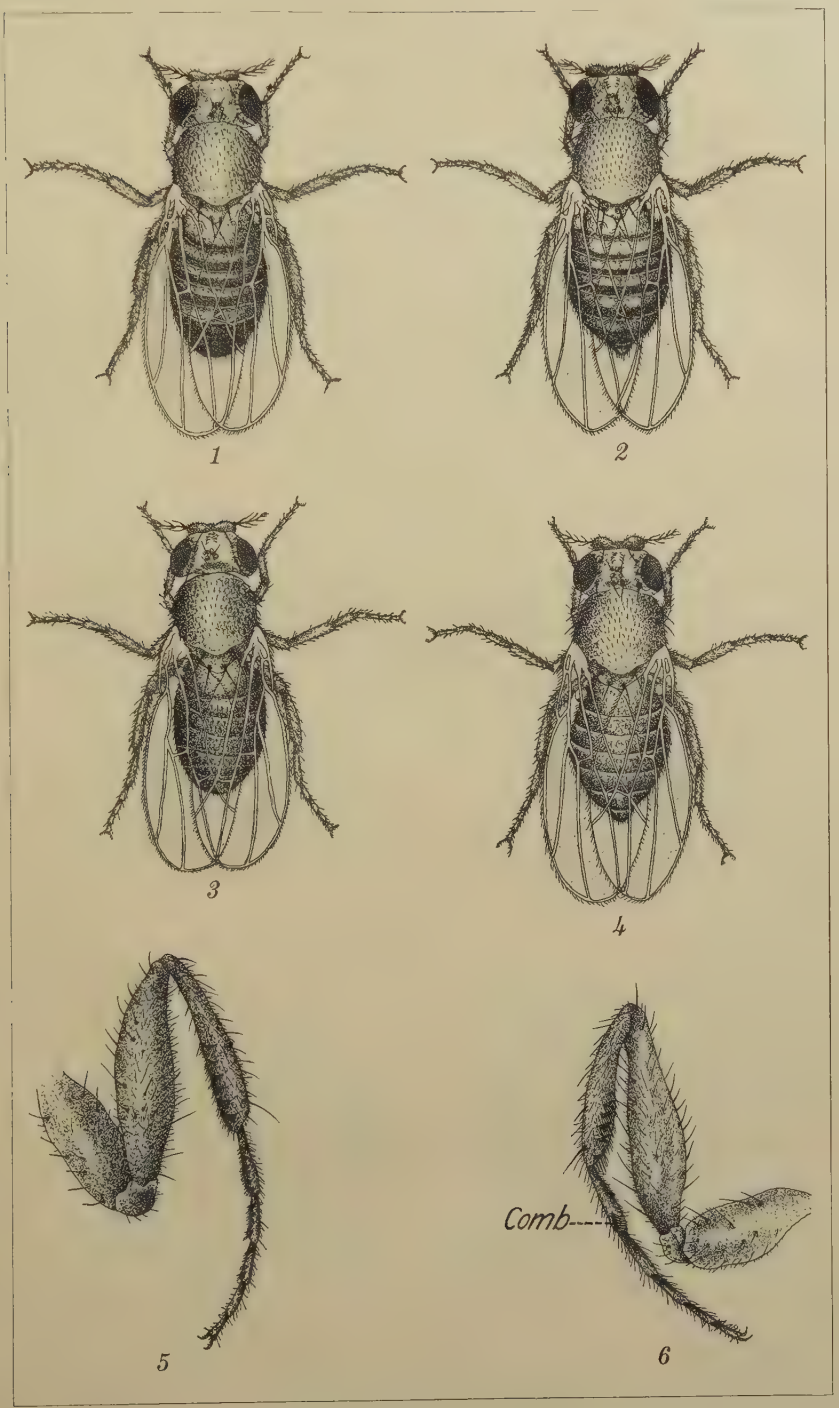

PLATE 1.

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PLATE 2.

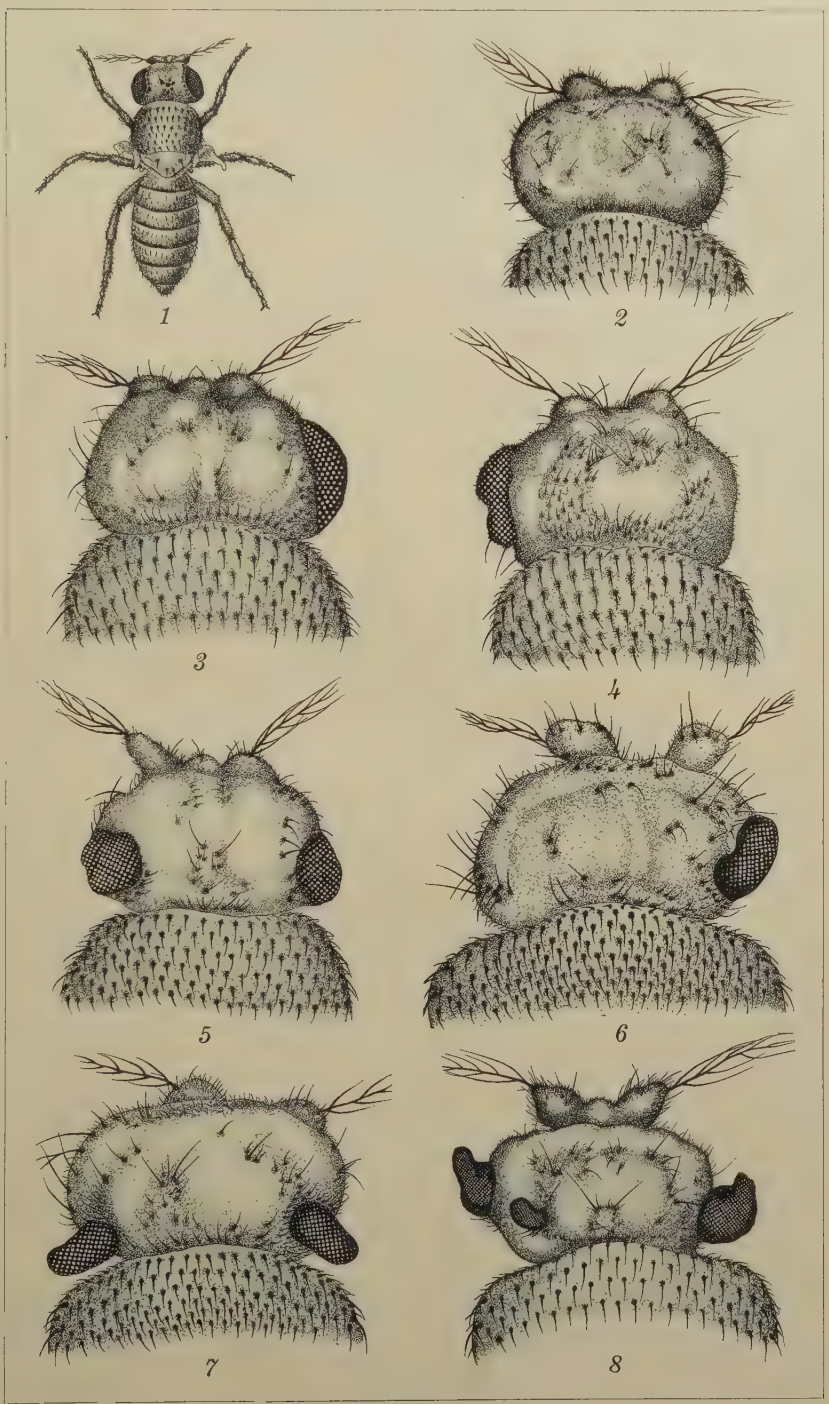

PLATE 3.

DETERIORATION OF HYPOCHLORITES

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THREE TEXT FIGURES

"Bleaching powder," or "calcium hypochlorite," is extensively used as a disinfectant. The chemical is cheap and relatively much easier to handle than other disinfectants of similar properties. However, it possesses the inconvenience of losing its activity on storage. Another useful disinfectant is "sodium hypochlorite." Like calcium hypochlorite it also deteriorates on standing.

"Bleaching powder" is mainly used in the disinfection of swimming pools and municipal water supplies; "sodium hypochlorite" is used in the disinfection of domestic drinking waters, domestic utensils, hospital wares, and clinical instruments.

The substances used in these tests for purposes of observation were prepared in the laboratory from commercial slaked lime and from solutions of commercial sodium hydroxide, treated with chlorine gas until the desired strengths were obtained. A solution of sodium hypochlorite prepared from chemically pure sodium hydroxide and distilled water is also included in the tests for purposes of comparison.

TEST SAMPLES

The chlorinated lime was divided into two portions. One portion was packed in four 10-gallon capacity wooden boxes, covered with asphaltum inside and out. The boxes were practically moisture proof at the time of packing. The other portion was placed in 7 cubic centimeter amber-colored glass vials, each tightly stoppered with rubber stoppers. Two of the wooden cases and several vials were stored in a refrigerator wherein the temperature oscillated between 8° C. and 12° C. The other two wooden boxes and the rest of the vials were stored in the laboratory at an average temperature of 29° C. In the same manner, the sodium hypochlorite solution was distributed in several 200 cubic centimeter and 700 cubic centimeter dark-colored bottles. The bottles were also divided into two lots;

one lot was stored in the refrigerator, and the other lot in the laboratory. The test samples were analyzed every month for their content of available chlorine following the standard methods of analysis.[1]

DISCUSSION OF RESULTS

The results of tests are shown in Tables 1 and 2. The same results are graphically represented in figs. 1 and 2.

TABLE 1.—*Deterioration of chlorinated lime on storage.*

Storage period.	Stored in wood boxes of 10-gallon capacity.		Stored in 7 cc colored vials, tightly stoppered.	
	In the refrigerator.	In the laboratory.	In the refrigerator.	In the laboratory.
Original strength	29.52	29.52	29.53	29.53
One month	29.11	22.32	29.20	25.39
Two months	28.70	16.40	28.92	21.65
Three months	28.11	11.26	28.70	18.03
Four months	27.46	6.96	28.25	15.00
Five months	27.10	4.82	27.99	11.93
Six months	26.71	2.90	27.50	9.82
Seven months	26.41	1.91	27.15	7.23
Eight months	25.96	1.08	27.00	5.97
Nine months	25.66	0.67	26.63	4.43
Ten months	25.00	0.36	26.20	3.26
Eleven months	24.70	0.35	26.00	2.03
Twelve months	24.31	0.13	25.60	1.20
Thirteen months	23.92	0.07	25.35	0.95
Fourteen months	23.30	0.02	25.13	0.12

The curves may be considered as the theoretical curves that would be obtained under ideal uniform conditions. The points show the actual values of monthly deterioration. Their deviation from the curves may be interpreted as indicating variation of temperatures, which is relatively little, variation of moisture and other atmospheric conditions.

The chlorinated lime stored in wooden boxes appears to have deteriorated faster than the same material stored in colored vials. This is true not only of samples stored in the laboratory, but also of samples stored in the refrigerator. These results seem to agree to a certain extent with those obtained by McDonnell and Hart[2] who indicated that chlorinated lime stored

[1] Scott, W. W., Standard Methods of Chemical Analysis. 4th ed., D. Van Nostrand Co., New York 1 (1925) 151 and 154.

[2] U. S. Dept. of Agr. Bull. 1389 (1926) 13.

in fiber containers deteriorated relatively faster than the same material stored in glass bottles.

There is, however, one important difference between the results obtained by McDonnell and Hart,[3] who worked under conditions prevailing in the United States, and the results obtained in this work. According to them, the available chlorine in most samples of chlorinated lime packed in containers of the usual commercial type decreased fairly regularly during storage; the decrease of available chlorine in this work under ordinary Philippine conditions is fairly rapid at first, then it becomes slower as the quantity of available chlorine is smaller. This is true of samples stored in the laboratory. The samples stored in the refrigerator decreased in strength almost regularly within the fifteen months' storage.

TABLE 2.—*Deterioration of sodium hypochlorite solution on storage.*

Storage period.	Prepared from solution of chemically pure sodium hydrate in distilled water.		Prepared from solution of commercial sodium hydrate in tap water.	
	In the refrigerator.	In the laboratory.	In the refrigerator.	In the laboratory.
Original strength	4.49	4.49	4.47	4.47
One month	4.46	4.22	4.45	4.25
Two months	4.43	4.08	4.44	4.03
Three months	4.42	3.88	4.44	3.80
Four months	4.41	3.76	4.41	3.59
Five months	4.38	3.53	4.39	3.41
Six months	4.36	3.45	4.37	3.25
Seven months	4.34	3.30	4.35	3.07
Eight months	4.31	3.12	4.34	2.93
Nine months	4.30	3.01	4.30	2.74
Ten months	4.26	2.96	4.27	2.59
Eleven months	4.22	2.90	4.23	2.47
Twelve months	4.20	2.81	4.20	2.34
Thirteen months	4.15	2.73	4.15	2.25
Fourteen months	4.11	2.68	4.11	2.16
Fifteen months	4.07	2.64	4.07	2.07
Sixteen months	4.05	2.60	4.03	1.98

Macculoch[4] has demonstrated that a sample of bleaching powder manufactured in England contained 35 per cent available chlorine; on reaching Madras it was reduced to 20.04 per cent, and six weeks afterwards, it contained only 12.52 per cent, a reduction of 37 per cent in six weeks under tropical con-

[3] Loc. cit.

[4] Journ. Soc. Chem. Ind. No. 19 40 (1921) 240T.

ditions. This result agrees very well with that obtained in this work from chlorinated lime packed in wooden barrels and stored in the laboratory (see fig. 1). In 1.4 months (6 weeks), there was a decrease of available chlorine from 20 per cent to 12.4 per cent, or a reduction of 37 per cent.

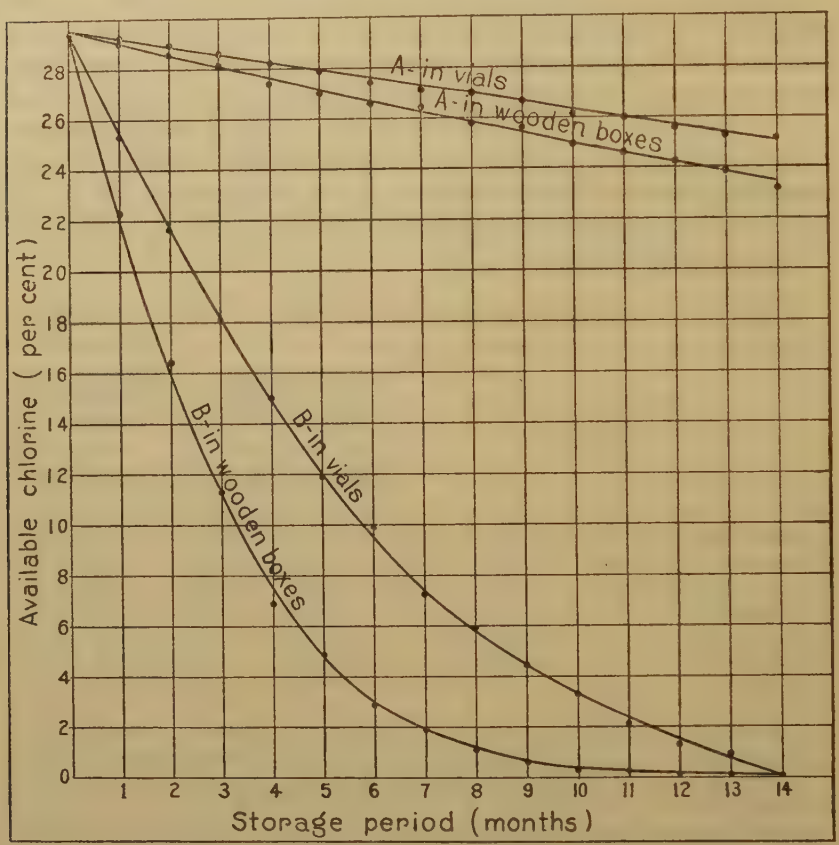

FIG. 1. Deterioration curves of chlorinated lime. A, stored in the refrigerator at 8 to 12° C B, stored in the laboratory, average temperature 29° C.

It is to be noted in this connection, that the samples packed in wooden boxes were found moist at the end of the test, indicating absorption of moisture, in spite of the precautions taken by covering the boxes with asphalt inside and out. This moist condition of the samples, possibly, has been one of the causes of the relatively more rapid deterioration of the chlorinated lime kept in the wooden barrels, as compared with that kept in glass vials.

In regard to the deterioration of sodium hypochlorite, or chlorinated soda, it is also apparent from Table 2 and fig. 2 that the rate of loss of available chlorine is greater at higher concentration and less at lower concentration. It is also apparent that the sodium hypochlorite solution prepared from tap water and commercial sodium hydrate, deteriorated faster than the sodium hypochlorite prepared from chemically pure sodium hydrate and distilled water, indicating that the rate of decomposition is affected by the impurities contained in the samples. In the refrigerator, however (at temperatures 8° C. to 12° C.), the rates of deterioration of the two solutions were practically the same.

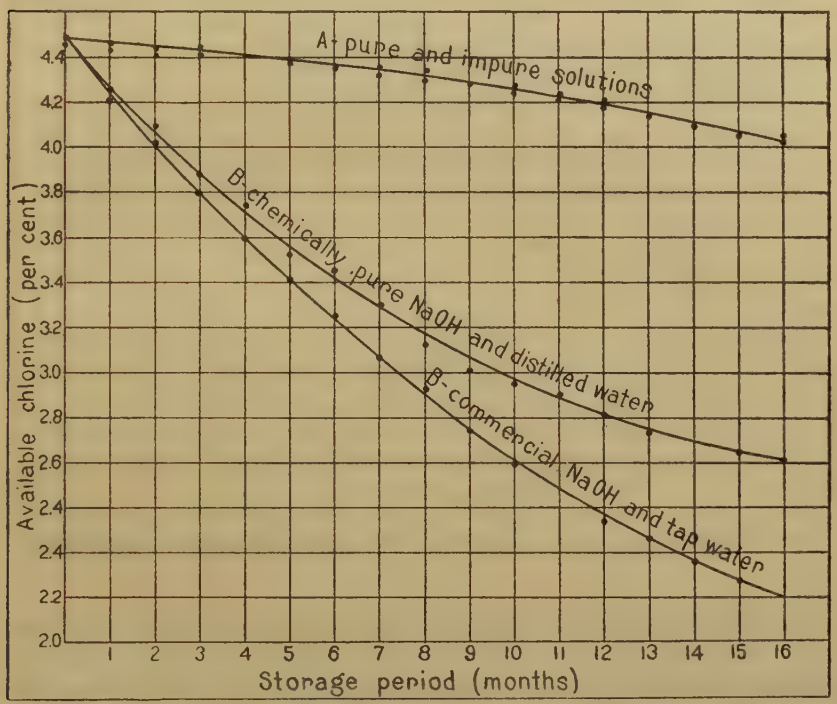

FIG. 2. Deterioration curves of sodium hypochlorite solutions. A, stored in the refrigerator at 8 to 12° C. B, stored in the laboratory, average temperature, 29° C.

Tests made of the content of available chlorine of chlorinated soda, or "hychlorite," [5] under conditions prevailing in temperate regions, indicated a rate of loss varying from 12 per cent to 24.8 per cent per year. The original chlorine content of the

[5] Am. Med. Assoc. Chem. Lab. Reports 11 (1918) 81.

solutions were 3.85 per cent and 4.18 per cent. In this work, starting from a concentration of 4.48 per cent, the losses after twelve months were 37.4 per cent and 47.6 per cent of pure and impure samples, respectively.

That the losses at higher concentration are greater than those at lower concentration has been already reported by Wells,[6] who stated that in three solutions, having original concentrations of available chlorine of 8.42, 11.32, and 13.28 per cent, after over three months the concentrations came down to practically 6 per cent for the three solutions, the loss of available chlorine being 29, 47, and 55 per cent, respectively.

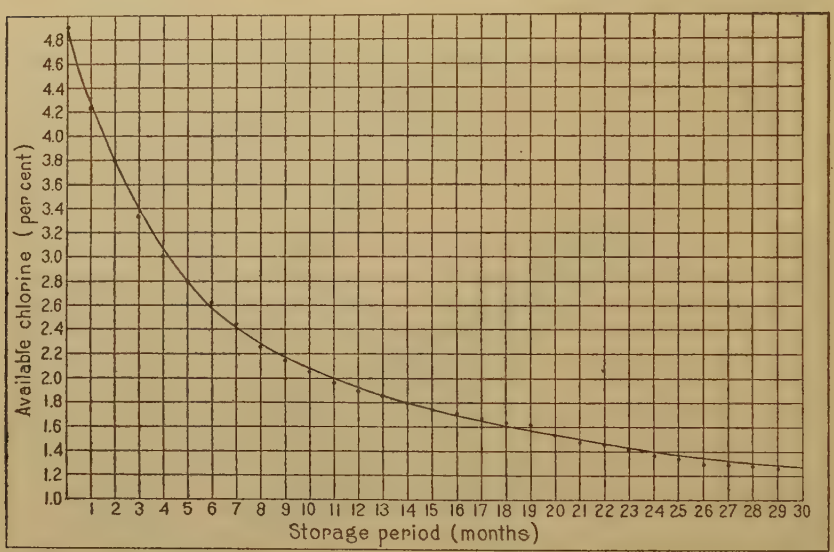

FIG. 3. Deterioration curve of commercial sodium hypochlorite solution manufactured in the Philippines.

As additional data corroborating the results herein reported, it is believed, that the observations[7] made at the Bureau of Science at the request of a local manufacturer, on the deterioration of a sample of commercial sodium hypochlorite, would be of interest. The results comprising a period of thirty months are plotted in fig. 3. It may be observed that the general aspect of the deterioration curve is similar to the deterioration curves shown in fig. 2.

[6] Am. Journ. of Pharm. 98 (1926) 405.

[7] The greater portion of the observations were made by Lourdes Ocampo, chemist, Bureau of Science.

Tests have also been made on the rate of deterioration of the hypochlorite solution contained in loosely stoppered bottles. The results obtained indicate that solution placed in loosely stoppered bottles, under identical conditions, deteriorates at practically the same rates as solutions of the same strength kept in tightly stoppered bottles.

Differences in the size of the bottles do not produce perceptible differences in the rates of deterioration.

SUMMARY

1. The deterioration of bleaching powder and sodium hypochlorite solution, under Philippine conditions, is not uniform and regular. It is more rapid at higher concentration, becoming slower at lower concentration.

2. Stored in a refrigerator at temperatures of 8° C. to 12° C. the monthly deterioration losses appear to be uniform and relatively small.

3. Commercial hypochlorite solutions deteriorate faster than chemically pure preparations of the same strength.

ILLUSTRATIONS

TEXT FIGURES

FIG. 1. Deterioration curves of chlorinated lime. A, stored in the refrigerator at 8° to 12° C. B, stored in the laboratory, average temperature 29° C.

2. Deterioration curves of sodium hypochlorite solutions. A, stored in the refrigerator, at 8° to 12° C. B, stored in the laboratory, average temperature, 29° C.

3. Deterioration curve of commercial sodium hypochlorite solution manufactured in the Philippines.

STUDIES ON EARLY LEPROSY IN CHILDREN OF LEPERS, II

REËXAMINATION OF CASES AFTER FIVE YEARS

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In 1922, Gomez, Avellana and Nicolas [1] made a survey of three hundred eight children born of leper parents who were then living in the Culion Leper Colony. In the latter part of 1924, I examined [2] three hundred ninety-eight of these children and endeavored to secure additional data bearing on the incidence of leprosy as to age and sex among them; the factors influencing transmission during intrauterine life, infancy, and early childhood; the nature of the initial lesion; and the effects of early and delayed separation of such children from leper surroundings.

Of the three hundred ninety-eight children living at Culion as of December 31, 1924, fifty-nine (14.8 per cent) were found to have become "confirmed" cases of leprosy (bacteriologically positive); eleven (2.8 per cent) had leprotic lesions, which however were bacteriologically negative ("clinical lepers" or "closed" cases); ninety-seven (24.4 per cent) showed signs "suspicious" of leprosy; and two hundred thirty-one (58 per cent) had no visible lesions and were considered "nonlepers." Thirty-two were living in the Negative Children's Home situated at Balala, the nonleper settlement; the rest were living with their parents or leper guardians in the colony itself. Of the latter, fifty-three were less than 1 year of age.

Previous to the 1924 survey, only a few of the children born in the colony of leper parents were being transferred to the Negative Children's Home. Separation after birth was attempted at the beginning, but most of the infants thus segregated died, and the parents refused to give up their children

[1] Philip. Journ. Sci. 21 (1922) 233–256.

[2] Rodriguez, Philip. Journ. Sci. 31 (1926) 115–145.

until they were old enough to be weaned. Thereafter, only some of the older children, from 6 months to 11 years of age, were isolated. They were carefully examined before admission, and only those that showed no suspicious signs were admitted.

No child above the age of 6 months was allowed to be taken away from the Colony unless it had been placed under observation in the Negative Children's Home for four consecutive years and had not shown any suspicious lesions of leprosy during that time.

Up to the time of the 1924 survey, one hundred twenty-three children had been admitted to this home. Of this number, 23 per cent developed leprosy during the period of isolation and were returned to the colony as lepers. Among those who were not isolated in the home and had remained continuously with their parents, only 11.5 per cent developed leprosy. Although direct comparison of these two groups is not possible due to reasons explained in my first article, it seems quite evident that delayed segregation of the children of lepers did not prevent the development of the disease in many of the Culion children. In order to be effective, isolation has to be from the time of birth or as shortly thereafter as possible. At any rate, it must be accomplished before the sixth month. Furthermore, it seems that the kind of care and the adequacy of food have a more important bearing on the development of leprosy than segregation per se, if this is delayed beyond six months.

After the 1924 survey, important changes in the management of Culion children took place. Following the order of superior authorities, all children in the colony above the age of 2 years, including those living at home, were sent to Manila during the latter part of 1925 and the first months of 1926, and placed under the care of the Public Welfare Commissioner. Moreover, it was implicitly ordered that all the children who were not positive bacteriologically were to be brought to Manila, and as a result, many bacteriologically negative but suspicious and clinical lepers were included among those taken to Manila.

A few months after the transfer of these children was effected, a severe epidemic of dysentery occurred among them at Manila. By April 30, 1926, seventy-one of the two hundred eighty-nine children transferred had died. Partly on account of this epidemic and partly because many of the parents at Culion were unwilling to give up their children, a large number

of the transferred children were discharged and given to reliable relatives and guardians outside the colony, with the condition that they were to be presented to the local health officers for examination every three months. As a matter of fact, many of them were never examined after discharge, and this in spite of the fact that some of them were probably suspicious lepers and a few even considered clinical lepers at the time of discharge.

The older children from Culion are now living at Welfareville in Mandaloyon, Rizal, in the suburbs of Manila. There were sixty-eight girls and ninety-six boys there by December 31, 1929. Of these, my records show that only ninety were examined in the 1924 survey. They are housed in a clean and well-ventilated building and receive the best of care and attention. Practically all of them go to school and the older ones are taught some trade or business so that they may be able to shift for themselves when they become of age.

At Culion, the older Negative Children's Home has been remodelled and converted into a nursery. The staff has been also much improved. The present policy is to remove to the nursery at birth or as shortly thereafter as possible all children born in the colony. When the children reach the age of 2 years, they are sent to Manila and placed at Welfareville.

Exactly five years after my first survey, or during October, November, and December, 1929, I endeavored to trace as many of the three hundred ninety-eight children examined during the first survey as possible. Those remaining at Welfareville, at San Lazaro, and at Culion were reëxamined. Letters were sent to trace those who had been discharged from Welfareville and from the Negative Children's Home. Records at Welfareville, San Lazaro, and Culion bearing on these children were freely consulted.

PRESENT SURVEY

Of the three hundred ninety-eight children examined in 1924, I could no longer trace and identify sixty-two of the youngest, due to destruction and irrevocable loss of part of my records during an absence from the Philippines in 1926.

As of December 31, 1929, of the three hundred thirty-six whose records could be traced, fifty had been rendered negative and paroled after having been positive (five of these were at Welfareville) ; thirty-one were still lepers living either at Culion or San Lazaro; fifty-six had died; ninety were at Welfareville

(including the five paroled ex-lepers) ; one hundred six had been discharged and given to nonleper relatives and guardians; one was at Culion, a helpless paralytic but nonleper; one was at Santol Tuberculosis Sanatorium; and one was being kept at San Lazaro as a clinical leper.

Only forty-nine of the one hundred six discharged children could be located by writing to their guardians or relatives and only three of them could be examined by the writer. These three were found nonlepers, but two others who had gone to Culion to visit their parents were found "positive lepers" by the Culion staff.

At Welfareville, five of the children were "negative" or "arrested" ex-lepers; thirteen still had suspicious signs of the disease; four showed acnotenic lesions, although they have never been found positive and the lesions had remained stationary for over two years; and sixty-eight were considered nonlepers.

POSITIVE LEPERS

In spite of certain objectionable features, the original classification of the Culion children into "positive lepers," "clinical lepers," "suspicious lepers," and "nonlepers," adopted by Gomez, Avellana, and Nicolas has been followed in the present survey to make it possible to compare the present results with previous findings. Including those discovered in 1922, and dealing only with those born previous to December 31, 1924, eighty-five are known to have developed leprosy, the diagnosis being confirmed in each instance by bacteriological examination. Lara and Nicolas [3] reported three additional cases that were born after 1924 and are therefore not included in the eighty-five cases here being reported.

Four of the eighty-five cases who became lepers died, fifty were paroled after all signs of activity had disappeared and repeated bacteriological examinations had proved negative for six months or more, and thirty-one were still segregated, either at Culion or at San Lazaro. Four of the latter, however, have been declared "quiescent" and were to be paroled in due time; the rest had active signs of the disease.

The number becoming positive from year to year is given in Table 1.

[3] Journ. Philip. Is. Med. Assoc. 9 (1929) 321–326.

TABLE 1.—*Showing number of positive cases discovered yearly from 1922 to 1929 inclusive.*

Year	Number found positive.
1922 and previous	24
1923	22
1924	16
1925	14
1926	2
1927	3
1928	2
1929	2
Total	85

De Vera [4] reports that no new case of leprosy has been discovered among the children remaining at Culion after 1927, so that all the four positive cases discovered in 1928 and 1929 came from Welfareville.

There is a sudden drop in the number of cases becoming positive after 1925. The possible causes for this diminution are: (1) Fewer cases under observation due to discharge of many of the children, including some suspicious cases and clinical lepers; (2) intensive treatment of "clinical lepers;" (3) the transfer of the older children to Manila; and, most important of all, (4) the early segregation of the younger ones at the nursery at Balala.

As to sex, forty-four of those who have become lepers were males and forty-one were females. The proportion between males and females in the whole group whose records can be traced is one hundred fifty-nine boys and one hundred seventy-seven girls. The relative proportion of those becoming positive among the boys is somewhat higher (28 per cent) than those becoming lepers among the girls (23 per cent).

The average age at which children were found clinically and bacteriologically positive among the fifty-nine positive lepers in the 1924 survey was 5 years 9 months. The average age of the twenty-six lepers discovered after 1924 was 7 years 2 months.

It is still not generally recognized that it is possible to make a diagnosis of leprosy before the lesions become bacteriologically positive. In ten of the eighty-five cases that became positive, undoubted clinical signs of leprosy ("clinical lepers") were seen

[4] Journ. Philip. Is. Med. Assoc. 10 (1930) 457–469.

from three months to four years before the presence of bacilli was finally demonstrated on the skin or nasal membranes. In three, fourteen, and four other patients, suspicious lesions ("suspected lepers") existed two, three, and four years, respectively, before the cases were found positive bacteriologically. In four children, the suspicious lesions were present for two years, then disappeared for one year, and then returned, becoming bacteriologically positive. In two other cases, the suspicious signs which persisted unchanged for two years finally became clinically leprotic but bacteriologically negative and remained thus for one more year, at the end of which period the lesions, but not the nasal mucosa, showed the presence of *Mycobacterium lepræ*, making a total of thirty-seven cases where suspicious or definite lesions of leprosy were detected from a few months to four years before the presence of the organism could be demonstrated.

On the other hand, there were twenty-four children who had been periodically examined for periods ranging from one to four years, with not a single child showing the least suspicious symptom or blemish whatever; quite suddenly, typical leprotic lesions appeared, and these were found positive bacteriologically at the first examination.

The typical leprotic lesions and the usual sites of predilection have already been fully discribed in the first survey and will not be discussed again in this paper.

However, it may be instructive to know whether or not the suspected patches actually developed into active leprotic lesions. Accurate data regarding this point are available for only eight clinical lepers and thirty suspected lepers who subsequently developed bacteriologically positive lesions. Among the clinical lepers, the same lesion clinically diagnosed as leprotic at the onset became "positive" in seven cases; in the remaining case, a new lesion appeared and this was the first to become positive bacteriologically.

In the thirty children who presented suspicious macules, the same suspected lesions eventually were found positive in twenty-four cases; in the rest, the positive smears were obtained from other sites, either from the ear lobes or from new patches. In no case were smears found positive in the nasal mucosa before the organisms could be demonstrated in the skin.

CLINICAL LEPERS

Fifty-one cases showed undoubted leprotic lesions consisting of typical pale or reddish macules presenting definite anæsthesia,

and accompanied by subsidiary signs of leprosy such as thickened cutaneous nerves, enlarged lymphatic glands, anhydrosis, ichthyosis, etc. However, repeated bacteriological examinations of smears taken from various portions of the lesions as well as from the nasal mucosa were consistently negative, at least for some time. In ten cases such smears were finally found positive after a period ranging from three months to four years; the rest never reached the "positive" stage; that is, the organisms have never been demonstrated in the lesions or in the nasal mucous membrane. In these latter cases, the macules gradually faded with almost complete recovery from the anæsthesia in many of them. In others, all that remained were atrophied scars or acroteric lesions involving one or both of the upper extremities, which have remained unchanged for years. Such cases may probably be considered "arrested." The four clinical lepers living at Welfareville probably belong to this category.

Gomez and coworkers classified twenty children as clinical lepers in 1922. By the end of 1924, eight, or 40 per cent, had been declared positive or confirmed lepers. On the other hand, of the thirty-one cases that were classified as clinical lepers after 1924, only two progressed to the "positive" stage. It is believed that the marked reduction in the proportion of so-called clinical lepers who have developed bacteriologically positive lesions since 1924 is due largely to the antileprotic treatment. When a case is declared "clinically positive," intensive treatment including the so-called "plancha" method is invariably given by their physicians without waiting for the bacteriological examination to become positive.

SUSPICIOUS LEPERS

The so-called "suspicious" lesions need further elucidation. One of the commonest early manifestations of leprosy among the Culion children are the "pale macules," or the "depigmented patches," as others prefer to call them. These macules are generally irregular in shape (although the most usual shape is roughly oval), pale or fawn-colored, with non-elevated but fairly distinct borders, and with the surface free from scales. The size may vary from that of a rice grain to extensive areas covering a large portion of an extremity or the trunk. In older patches, perspiration is diminished or absent while the hair is scanty and deformed, or entirely absent.

In the Philippines, the pale macules of leprosy are frequently mistaken for *T. flava* by the laity and even by physicians. The

typical appearance of the macule, the lack of furfuraceous scales, and the distribution are so characteristic that after seeing a number of these lesions, confusion is hardly possible except in rare cases. If there is the least doubt, scrapings should be made and examined for the fungus. Even the attendants working in the Cebu Skin Dispensary are able to distinguish the typical pale macule of leprosy at a glance after seeing a score of early cases.

When anæsthesia is distinctly present, together with a thickening of the cutaneous nerve supplying the area, and the appearance of the macule is typical, a diagnosis of leprosy may be safely made, although the bacteriological examination may prove negative. Such cases were classified by Gomez and coworkers as "clinical lepers."

When the anæsthesia cannot be accurately determined as is usually the case in infants and young children, when the borders of the macules are not distinct, and particularly when the appearance is not typical, the lesion is diagnosed as "suspicious." Such lesions often have to be observed for months or even years before a definite diagnosis can be made. Due to the difficulty of proving the presence of anæsthesia in young children, there are naturally many more "suspicious" cases among them than among adults.

Among intelligent adult patients, and particularly where there are facilities for performing the proper laboratory examinations, including biopsy, there is hardly ever any need for this designation.

Another suspicious lesion, which to my knowledge has been described only in the Philippines, is a characteristic flushed, tense, and glistening appearance of the skin on the front of either one or both legs of children below the age of 2 years. As the child grows older, the involved skin becomes dry, harsh, and cracked, simulating very closely a moderately severe case of ichthyosis. I propose the designation of "Nicolas sign" for this condition, after Dr. Catalino Nicolas, the first clinician of Culion to notice it. All the children under my observation who developed this condition during infancy became lepers later on.

It is apparent that not all children temporarily classed as "suspicious" become lepers. However, the proportion becoming positive from suspicious cases is much higher than that developing from a group showing no suspicious lesions at all. For instance, only thirty-six children (12 per cent) developed de-

finite symptoms of leprosy from the group of two hundred six children classified as nonleprous by Gomez and coworkers, while fully 57 per cent became lepers in their suspicious group of fifty-eight children.

It has already been mentioned earlier in this paper that in eighteen cases, the suspicious lesions were detected three to four years before the presence of *M. lepræ* could be demonstrated in the lesions or in the nasal mucous membrane. This observation would seem to demonstrate that "suspicious" children of lepers should be kept under constant observation for at least four years. In fact, a longer observation period is probably necessary. Four of the children living at Welfareville at the end of 1929 showed suspicious lesions, which had been known to exist for at least seven years. At times, these lesions almost entirely disappeared only to reappear and become quite distinct again. Of course it is impossible to tell whether or not these suspicious lesions will ever become bacteriologically positive.

In going over the above data, the impression is obtained that the majority of Culion children have at one time or another shown either suspicious or definite signs of the disease. This is indeed the case. According to my records of the two hundred six children found nonleprous in 1922, to which I added thirty-three new cases in 1924, only eighty-five escaped from suspected or confirmed lesions of leprosy. Of this number, nineteen had died, twenty-six were at Welfareville, and forty had been discharged at the time of the present survey.

EFFECTS OF TREATMENT

The results of the antileprotic treatment among the Culion children who have become lepers has already been reported by other workers and need not be discussed further in this paper. In 1928, Nicolas and Roxas-Pineda [5] reported that among seventy leper children, most of whom were born at Culion, who were treated for periods ranging from ten months to five and one-half years, thirty-eight became negative or quiescent cases. Their paper discussed the relation of age and sex, kinds of drugs used, type and advancement of the disease and duration of treatment, to the results of the treatment. Lara and Nicolas reported the efficacy of the "plancha" or infiltration method of injecting the iodized esters of *Hydnocarpus wightiana* oil in six

[5] Journ. Philip. Is. Med. Assoc. 8 (1928) 314–316.

of these leper children. Four of them in the early stages became negative in one month, another became so after four months of treatment, while the only slightly more-advanced case required five months intensive treatment.

It has already been stated that fifty of these children have become quiescent cases through treatment. How many of these will continue to remain inactive permanently remains to be seen. According to available records, ten of these children have lived for some time at Welfareville, and of these, five have been found bacteriologically positive again. In three of them, there was a clinical reactivation, with appearance of new lesions.

It has also been noted earlier in this paper that vigorous treatment with antileprotic drugs has apparently diminished the number of clinical lepers who have become bacteriologically positive cases of leprosy since 1924.

There is still another important feature of the treatment, however, which has not yet been touched upon. Some workers have been advocating the employment of antileprotic drugs as a sort of "prophylactic" treatment to prevent the development of the disease in persons who have been exposed to the disease. Naturally, it would be very advantageous to know if such treatment is really effective.

Unfortunately, it was impossible to have well-controlled experimental groups under observation to settle this point definitely. However, certain pertinent data are available.

During the early part of September, 1924, Drs. Catalino Nicolas and Elisa Roxas-Pineda placed under treatment all children at Culion having suspicious lesions. Previous to this time, both of them had already been treating about fifteen of these cases. The nonleper children were also encouraged to receive injections.

According to their special reports dated October 15 and September, 1925, respectively, Nicolas and Roxas-Pineda treated, in all, eighty-three suspicious children for periods of time ranging from three months to four years; the majority received treatment for thirteen to fourteen months (from September, 1924). In seventy cases the children remained suspicious at the end of the treatment, although some degree of improvement in the lesion or lesions was noted in forty-eight of them; ten (12 per cent) had become either clinical or positive lepers; and in only three had the suspicious lesions disappeared. Recapitulating, it is demonstrated that of eighty-three suspicious cases placed under treatment for an average period of fourteen months, seventy, or 84 per cent, remained suspicious, while ten

(12 per cent) became clinical or bacteriologically positive lepers. Furthermore, of ten children presenting suspicious lesions treated by Nicolas and Roxas-Pineda for as long as from two to three years, eight had persisted as suspicious cases. However, it must be emphasized that all these children were living with their leper parents and, therefore, were continuously exposed to probable reinfection.

When it is recalled that many of the suspicious cases clear up and become nonleprous after some time, even without drug treatment, it becomes evident that the injections do not seem to be very effective in clearing up the suspicious lesions. On the contrary, of eighteen nonleper children who were injected more or less regularly by these same workers for about a year, sixteen had become suspicious, and only two remained symptom free. It must be repeated, however, that these workers had noted some degree of improvement in the extent and distinctness of the lesions, but apparently, the improvement was not marked enough to necessitate a change in classification of the cases. Furthermore, the dosage used for the suspicious cases as a rule was considerably less than that used for clinical and positive lepers. The injection of larger doses is attended with much pain and the drug is not uninjurious to certain vital organs, especially the kidneys, so that the physicians perforce had to be cautious in administering the treatment to children without definite lesions of leprosy.

When the drug treatment is given to the suspicious cases after they have been segregated, the results are somewhat more encouraging. It must be stated at the outset, however, that the records of the treatment of the segregated children were not as complete as could be desired.

In June, 1924, eighteen children having suspicious lesions and at that time segregated at the former Negative Children's Home at Balala, Culion, were given treatment with the iodized esters of *H. wightiana* oil. The injections were continued until they were transferred to Welfareville. Here, it is said that the injections were also given to all the children for a time, although no records are available. During the dysentery epidemic of 1926, the antileprotic injections were discontinued and were not resumed for some months.

It was not until September, 1927, when Dr. Elisa Roxas-Pineda took charge of the treatment of the Welfareville children, that records of the injections were kept. Only the suspicious cases were treated.

Only twelve of the eighteen children with suspicious lesions whose treatment was started in 1924 were at Welfareville at the time of the present survey. Two of these still had suspicious patches, two were clinical lepers, and eight, or about 66 per cent, were considered nonlepers.

Of the sixty-three Culion children who were considered "suspicious" at the time of transfer to Welfareville either in December, 1925, or in January of the following year, twenty-six, or almost 41 per cent, were found to be already clean and considered nonlepers at the end of 1929, while thirty-seven (59 per cent) were still suspicious. Five children transferred to Welfareville as "clinical lepers" had become nonlepers also, giving a total of forty-two children in a total of sixty-eight whose lesions had cleared up.

At the same time, five suspicious and clinically positive cases have become bacteriologically positive among the Welfareville children, in spite of the drug treatment.

From the foregoing observations, it would seem that the antileprotic drug treatment in suspicious children, even among segregated cases is of doubtful value, and that the so-called "prophylactic treatment" is not only unscientific but quite useless as well. Therefore, such treatment cannot be employed to shorten the necessary period of segregation for children who have been allowed to remain with their leper parents beyond the age of 6 months. This period of segregation should not be less than five years, whether the child is treated or not.

COMMENT

In following the development of leprosy among the Culion children through a period of several years, it is observed that in a typical case, there is a very gradual progress of the infection through the so-called "suspicious" (lasting from a few months to four years) and the "clinical leper" stages (lasting from a few weeks to four years) to a peak which begins to be reached when the organisms become demonstrable in the skin and mucous membranes. The bacilli usually appear in enormous numbers at these sites but eventually in the favorable cases, through the development perhaps of some degree of immunity and aided possibly by the drug treatment and especially by proper food and hygienic habits, the downward trend begins and the disease goes through a period of decreasing activity, until the skin and mucous membranes again become clear of organisms. Presumably, the trend continues downward through the subsequent stage of inactivity, arbitrarily

divided into "quiescent" and "arrested" periods, during which time the remaining organisms are gradually disposed of.

In some cases the suspicious or the clinical leper stage, or both, are skipped and the child becomes a "positive leper" directly from an apparently "nonleper" state.

The work in the Cebu Skin Dispensary indicates that the course of the disease in adults is essentially the same as in the leper children. However, the suspicious stage is practically nonexistent among adults and in its place there is a corresponding period characterized by the appearance of paræsthetic symptoms and signs of vasomotor instability, and less characteristically, by urticarialike rashes and epistaxis. The duration of this prodormal period is about the same as the suspicious stage in children.

I have yet to see a "tuberculoid" (zone) type of lesion in young children.

The drug treatment as a rule is not effective in the "suspicious" or "prodromal" and the early "clinical leper" stages, but due perhaps to the gradual development of some degree of immunity and partly to greater accessibility or vulnerability of the bacilli to the drug, its effects become more manifest after the organisms have appeared in their typical form in the dermis.

SUMMARY AND CONCLUSION

1. Three hundred ninety-eight children born in the Culion Leper Colony were traced and as many as possible were reexamined five years after they were first surveyed in 1924.

As of December 31, 1929, sixty-two could no longer be traced and identified due to destruction of part of my records. A total of fifty-six of the whole group had died, ninety were at Welfareville, and one hundred six had been discharged and placed under the care of nonleper guardians.

Eighty-five had become at one time or other "positive" or confirmed lepers and of these, fifty had become "negative" and paroled; thirty-one were still segregated at Culion or at San Lazaro Hospital in Manila as lepers, and four had died.

Only those who were living at Welfareville together with those still remaining at Culion and San Lazaro Hospital, and three of the discharged cases, could be reëxamined. Of the Welfareville children, five were "arrested" cases, thirteen had suspicious lesions of leprosy, and sixty-eight were considered nonlepers. Four of the thirty-one lepers still remaining in the leprosaria at the end of 1929 were already candidates for the "quiescent" period.

2. Since 1926, children born at Culion are transferred at birth, or as soon thereafter as possible, to a nursery in the nonleper settlement. Upon reaching the age of 2 years, they are taken to Welfareville, at Manila. From Welfareville a child may be given to a guardian, provided that after due investigation, the qualifications of the guardian are acceptable to the Public Welfare Commissioner or his authorized representatives.

3. There has been a very distinct diminution in the number found becoming bacteriologically positive since 1926. This drop is partly due to the favorable effect of the treatment among the clinical lepers, partly to the diminishing number under observation, also to the excellent care and good food given to the infants at the nursery at Culion and to the older children at Welfareville, but especially to the fact that since 1925, the children born at Culion have been separated from their parents very soon after birth. Adequate care and proper food are more effective in preventing the development of the disease among these children, than any medication.

4. The drug treatment as a rule is not effective in the "suspicious" or "prodromal" and the early "clinical leper" stages, but due perhaps to the gradual development of some degree of immunity and partly to greater accessibility or vulnerability of the bacilli to the drug, its effects become more manifest after the organisms have appeared in their typical form in the dermis.

5. Children removed from leper surroundings after the first six months of life should be segregated for at least five years. "Preventive" treatment with antileprotic drugs cannot take the place, nor shorten the duration, of this observation period.

6. It is possible to make a clinical diagnosis of leprosy months or years before the presence of *M. lepræ* can be demonstrated in the skin and mucous membranes by the ordinary methods of bacteriological examination.

7. A suspicious lesion that appears in infants less than 2 years of age, consisting of a flushed, tense, and shiny condition of the front of the legs, is described. The designation "Nicolas sign" is proposed for this condition.

ACKNOWLEDGMENT

Acknowledgment is due to Dr. Elisa Roxas-Pineda for the use of her personal records and reports on the Culion children in the preparation of this article.

A NEW SPECIES OF HOOKWORM FROM A PHILIPPINE CIVET

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ONE PLATE

January 30, 1930, Dr. E. W. Price, of the Bureau of Animal Industry, collected a number of hookworms from the small intestine of a Philippine civet (*Paradoxurus philippinensis*) which had died at the National Zoölogical Park, Washington, D. C. These worms belong to the genus *Uncinaria* and represent a new species for which the name *Uncinaria philippinensis* is proposed.

UNCINARIA PHILIPPINENSIS sp. nov.

Specific diagnosis. Uncinaria.—Anterior end bent dorsally. Buccal capsule 85 to 100 μ long by 75 to 90 μ wide in the female, and 80 to 95 μ long by 60 to 80 μ wide in the male, formed of heavily cuticularized plates; surface of buccal capsule does not present conspicuous sutures as found in *Uncinaria lotoris;* two large subventral cutting plates guard opening of mouth; ventral side of mouth opening laterally constricted. Four submedian papillæ and one pair of lateral organs or amphids are present. A pair of subventral teeth or lancets project from wall of buccal capsule near base of buccal cavity. Dorsal œsophageal gland opens at end of dorsal gutter. Musculature attached to dorsal side of buccal capsule is very conspicuous. Cuticle rather thick; striæ distinct.

Male 3.29 to 3.38 millimeters long by 180 to 200 μ wide. Œsophagus club-shaped, 420 to 440 μ long, with a minimum diameter of 40 μ in region of nerve ring and a maximum diameter of 60 to 65 μ near base of posterior enlargement of œsophagus. Nerve ring situated 200 to 210 μ from anterior end of body. Excretory pore a short distance posterior to nerve ring, 300 to 310 μ from anterior end. Excretory duct bends posteriorly from excretory pore and bifurcates, each branch entering an enormous subventral excretory cell which varies in length but

is usually about twice the length of the œsophagus. Spicules slender and setalike, 1.2 to 1.25 millimeters long, maximum diameter 6 to 8 μ at proximal end; distinctly striated except near distal end. Gubernaculum slender, 70 to 90 μ long, with a slight bend near posterior fourth of its length. Prebursal papillæ 180 μ from posterior end of body. Lateral bursal lobes nearly semicircular in contour. Dorsal ray bifurcates about three-fourths of its length from the anterior end forming secondary branches, each of which bifurcates to form tertiary branches, the innermost branches being bidigitate and thicker than the outer branches; thus the distal portion of the dorsal ray consists of two tridigitate branches, the inner digit in each case being the longest and the outer digit the shortest. Externolateral ray shorter than mediolateral. Posterolateral ray attached near the base of common stalk of externolateral and mediolateral rays, and usually slightly thicker than the other rays. The other rays do not differ from those of other members of the genus.

Female 3.3 to 3.5 millimeters long by about 200 μ wide at base of œsophagus, and 250 to 300 μ wide in region of vulva. Œsophagus 460 to 500 μ long with a minimum diameter of 44 μ in region of nerve ring and a maximum diameter of 88 μ at the base. Nerve ring situated 260 μ, and excretory pore 340 to 360 μ, from anterior end of body. Tail bluntly conical, 100 to 180 μ long, and provided with a fine point at its tip. Vulva 2.4 to 2.5 millimeters from anterior end of body. Eggs 60 to 66 μ long by 34 to 38 μ wide.

Host.—*Paradoxurus philippinensis.*

Location.—Small intestine.

Distribution.—National Zoölogical Park, Washington, D. C.

Type specimens.—United States National Museum helminthological collection, No. 29723; paratypes, No. 31272.

Uncinaria philippinensis is distinctly smaller than the three other species of the genus. The size varies little in a collection of thirty-five individuals. *Uncinaria lotoris* is characterized by the presence of distinct sutures in the buccal capsule, which sutures were not seen in *U. philippinensis.* The latter differs from *U. criniformis* in that the posterolateral bursal ray is thicker than the mediolateral. It differs from *U. stenocephala,* as also from the other species, in the proportionate, as well as the absolute, size of the spicules. These differences are brought out in the following key.

Key to the species of the genus Uncinaria.

1. Buccal capsule showing distinct sutures ..... *U. lotoris.*
   Buccal capsule not showing distinct sutures ..... 2.
2. Dorsal ray bifurcate, each branch bidigitate..... *U. criniformis.*
   Dorsal ray bifurcate, each branch tridigitate ..... 3.
3. Male 5.6 to 8 millimeters long, female 7.7 to 12 millimeters long; spicules 140 to 760 μ long..... *U. stenocephala.*
   Male 3.29 to 3.38 millimeters long, female 3.3 to 3.5 millimeters long; spicules 1.2 to 1.5 millimeters long..... *U. philippinensis.*

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ILLUSTRATION

PLATE 1. UNCINARIA PHILIPPINENSIS SP. NOV.

FIG. 1. Lateral view of head.
2. Dorsal view of head.
3. Lateral view of anterior end.
4. Lateral view of male tail.
5. Dorsal view of male tail.

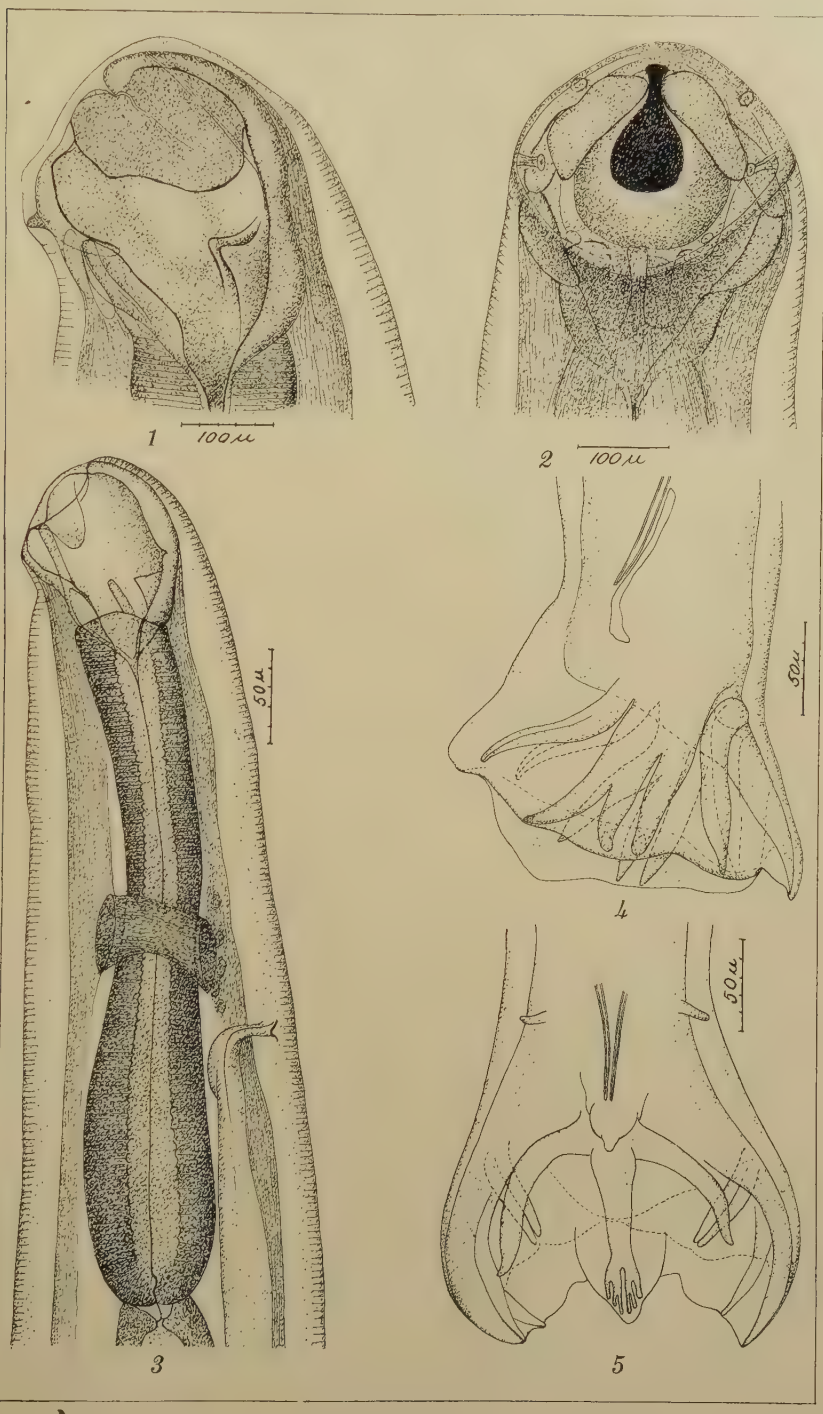

PLATE 1.

DIATOMS FROM THE BOTTOM OF THE SEA OF JAPAN

By B. W. Skvortzow

Of Harbin, China

FOUR PLATES

The diatoms described in the following paper were collected in 1921–1925 by the Imperial Fisheries Institute of Tokyo, Japan, and sent to me by the kindness of Dr. K. Okamura, director of that institute.

Five samples of sea mud were included in the shipment, as follows:

1. A sandy sea mud with small *Coscinodiscus* and various Naviculaceæ. Collected at 124° 52′ 10″ east, 35° 55′ 30″ north. November 14, 1923.

2. A sea mud with a large number of *Coscinodiscus* valves. Collected at 138° 13′ 00″ east, 38° 38′ 50″ north. July 10, 1921.

3. Also a *Coscinodiscus* mud. Collected at 142° east, 38° 17′ north. November 24, 1925.

4. A sea mud with radiolarians and large *Coscinodiscus* valves. Collected at 141° 42′ east, 38° 17′ north. December 21, 1925.

5. A calcareous mud with very few diatoms. Collected at 134° 56′ 30″ east, 39° 11′ 20″ north. July 10, 1921.

The material contained eighty-three species and varieties of diatoms, among which were found several new forms. The diatoms of the Sea of Japan are still relatively little known and our list can be of interest. The diatoms found in these collections are here enumerated. The number after each species corresponds to the particular locality from which it was obtained.

MELOSIRA SULCATA (Ehrenberg) Kützing forma CORONATA Grunow.

Length, 0.01 to 0.012 millimeter; breadth, 0.05. Geographic distribution: North and Mediterranean Seas. Samples 1 and 3.

PODOSIRA STELLIGER (Bailey) Mann.

V. Heurck, Synopsis. pl. 84, figs. 1, 2.

Diameter of the valve 0.059 to 0.062 millimeter. Geographic distribution: Pacific and Atlantic Oceans. Samples 2 and 4.

HYALODISCUS SUBTILIS Bailey.

PERAGALLO, Diatom. Mar. France. pl. 119, fig. 7.

Diameter of the valves 0.047 to 0.051 millimeter. Geographic distribution: Atlantic and Pacific Oceans. Samples 1, 2, and 3.

AULISCUS COELATUS Bailey. Plate 2, figs. 1 to 3.

A. SCHMIDT, Atlas Diatom. pl. 32, figs. 14 to 20.

Diameter of the valves 0.042 to 0.062 millimeter. Geographic distribution: Atlantic and Pacific Oceans. Sample 1.

CERATAULUS TURGIDUS Ehrenberg.

V. HEURCK, Synopsis. pl. 104, figs. 1, 2.

Diameter of the valves 0.068 to 0.01 millimeter. Geographic distribution: Atlantic and Pacific Oceans. Sample 1.

CYCLOTELLA STRIATA (Kützing) Grunow.

V. HEURCK, Synopsis. pl. 92, figs. 6 to 8.

Diameter of the valve 0.032 millimeter. Striæ 12 in 0.01 millimeter. Geographic distribution: Brackish and marine waters. Sea of Japan, Yellow Sea, Atlantic and Pacific Oceans. Samples 1, 2, 3, and 4.

BIDDULPHIA GRUNDLERI A. Schmidt. Plate 2, fig. 4.

A. SCHMIDT, Atlas Diatom. pl. 118, figs. 22 to 24.

Geographic distribution: Pacific Ocean and Sea of Japan. Samples 2 and 4.

BIDDULPHIA RETICULATA Roper.

A. SCHMIDT, Atlas Diatom. pl. 121, figs. 11 to 15.

Length, 0.051 millimeter; breadth, 0.034. Geographic distribution: Celebes, Sandwich Islands, Java, Sea of Japan, Ceylon. Samples 1, 2, and 3.

BIDDULPHIA AURITA (Lyngb.) Brébisson.

V. HEURCK, Synopsis pl. 98, figs. 4 to 9.

Length, 0.6 to 0.07 millimeter; breadth, 0.035. Geographic distribution: Adriatic Sea and Pacific Ocean. Samples 1, 2, and 3.

BIDDULPHIA LONGICRURIS Greville. Plate 4, figs. 8, 10.

A. SCHMIDT, Atlas Diatom. pl. 118, fig. 10.

Length, 0.054 millimeter; breadth, 0.017 to 0.034. Our valves were without horns. Geographic distribution: Honkong, Japan. Sample 5.

ARACHNOIDISCUS EHRENBERGII Bailey var. CALIFORNICA Grunow. Plate 1, fig. 9.

A. SCHMIDT, Atlas Diatom. pl. 68, figs. 3 to 4.

Diameter of the valves 0.165 to 0.195 millimeter. Geographic distribution: Sea of Okhotsk, Bering Sea, Aleutian and Honshu Islands, Japan, Yokohama. Sample 1.

ACTINOPTYCHUS PARVUS Mann. Plate 1, fig. 10.

Marin. Diatom. Philippine Islands. (1925) 15, pl. 1, fig. 8.

Diameter of the valves 0.055 to 0.062 millimeter. Geographic distribution: Atlantic and Pacific Oceans, Philippines, Sea of Japan. Samples 1 and 3.

ACTINOPTYCHUS UNDULATUS (Bailey) Ralfs.

V. HEURCK, Synopsis. pl. 122, figs. 1, 3.

Diameter of the valves 0.051 millimeter. Geographic distribution: Atlantic and Pacific Oceans. Samples 1, 3, 5, and 6.

ASTEROMPHALUS CLEVEANUS Grunow. Plate 4, fig. 1.

A. SCHMIDT, Atlas Diatom. pl. 38, figs. 13 to 14.

Diameter of the valves 0.068 to 0.096 millimeter. Geographic distribution: Java, Manila, Indian Archipelago, Japan Sea. Samples 4 and 5.

ASTEROMPHALUS HUMBOLDTII Ehrenberg. Plate 4, fig. 2.

A. SCHMIDT, Atlas Diatom. pl. 38, figs. 18 to 20.

Diameter of the valves 0.068 to 0.072 millimeter. Geographic distribution: Indian Archipelago. Samples 4 and 5.

ACTINOCYCLUS EHRENBERGI Ralfs.

V. HEURCK, Synopsis. pl. 123, fig. 7.

Diameter of the valves 0.093 millimeter. Geographic distribution: A cosmopolitan diatom. Samples, 2, 3, and 4.

ACTINOCYCLUS EHRENBERGI Ralfs var. CRASSA (W. Smith) Hustedt.

V. HEURCK, Synopsis. pl. 124, figs. 6, 8.

Diameter of the valves 0.083 millimeter. Geographic distribution: North sea. Sample 2.

COSCINODISCUS LINEATUS Ehrenberg.

A. SCHMIDT, Atlas Diatom. pl. 59, figs. 31, 32.

Geographic distribution: A cosmopolitan diatom. Samples 3, 4, and 5.

COSCINODISCUS CONCINNUUS W. Smith.

A. SCHMIDT, Atlas Diatom. pl. 144, figs. 8, 9.

Geographic distribution: Atlantic and Pacific Oceans. Samples 4 and 5.

COSCINODISCUS EXTRAVAGANS A. Schmidt. Plate 1, fig. 1.

A. SCHMIDT, Atlas Diatom. pl. 58, fig. 33.

Diameter of the valve 0.072 millimeter. Central space circular. Markings small, granular, about 9 to 10 in 0.01 millimeter, in radial rows, fasciculate. Border distinct, striated. Geographic distribution: Sea of Japan. Samples 3 and 4.

COSCINODISCUS OKAMURÆ sp. nov. Plate 1, fig. 6.

Diameter of the valves 0.037 to 0.04 millimeter. Central space large, about one-third of the diameter broad, irregular. Markings round, granula 5 to 6 in 0.01 millimeter, with central distinct papillæ, all of the same size. Border distinct, toward the border passing in spiral lines. Border 0.0017 to 0.002 millimeter broad, with coarse striæ, 12 in 0.01 millimeter. Sample 1. Named in honor of Dr. K. Okamura.

COSCINODISCUS JANISCHII A. Schmidt.

A. SCHMIDT, Atlas Diatom. pl. 64, figs. 3, 4.

Diameter of the valves 0.165 to 0.196 millimeter. Markings 3 to 4 in 0.01 millimeter. Geographic distribution: Atlantic and Pacific Oceans. Samples 4 and 5.

COSCINODISCUS OCULUS IRIDIS Ehrenberg.

A. SCHMIDT, Atlas Diatom. pl. 63, figs. 6, 7, 9.

Diameter of the valves 0.125 to 0.165 millimeter. Geographic distribution: A cosmopolitan diatom. Samples 3, 4, and 5.

COSCINODISCUS RADIATUS Ehrenberg. Plate 1, fig. 2.

A. SCHMIDT, Atlas Diatom. pl. 60, figs. 1 to 6, 9, 10; pl. 61, fig. 13; pl. 65, fig. 8.

Diameter of the valve 0.098 millimeter. Markings 2 to 3 in 0.01 millimeter. Geographic distribution: A cosmopolitan diatom. Samples 3, 5, and 6.

COSCINODISCUS RADIATUS Ehrenberg var. MINOR A. Schmidt.

A. SCHMIDT, Atlas Diatom. pl. 60, figs. 1 to 4.

Diameter of the valves 0.025 to 0.044 millimeter. Markings 4 to 6 in 0.01 millimeter. Geographic distribution: Common with the typical form. Samples 3, 5, and 6.

COSCINODISCUS MARGINATUS Ehrenberg. Plate 1, fig. 7.

A. SCHMIDT, Atlas Diatom. pl. 62, figs. 1 to 5, 7, 9, 11, 12.

Diameter of the valves 0.085 to 0.12 millimeter. Geographic distribution: Pacific and Atlantic Oceans. Sea of Japan. Samples 3, 4, and 5.

COSCINODISCUS CURVATULUS Grunow. Plate 2, fig. 5.

GRUNOW, Diatom. Franz Josef Land. p. 83, pl. D. figs. 9, 11, 12.

Diameter of the valves 0.093 to 0.1 millimeter. Markings 5 to 7 in 0.01 millimeter. Geographic distribution: Atlantic and Pacific Oceans. Samples 4 and 5.

COSCINODISCUS OBSCURUS A. Schmidt. Plate 1, fig. 5.

A. SCHMIDT, Atlas Diatom. pl. 61, fig. 16.

Diameter of the valve 0.056 millimeter. Markings 3 to 3.5 in 0.01 millimeter. Geographic distribution: Pacific Ocean and fossil.

COSCINODISCUS EXCENTRICUS Ehrenberg. Plate 1, fig. 4.

A. SCHMIDT, Atlas Diatom. pl. 58, figs. 46 to 49.

Diameter of the valve 0.075 to 0.086 millimeter. Markings 3 to 4 in 0.01 millimeter. Geographic distribution: A cosmopolitan diatom. Samples 1, 2, 3, 4, and 5.

COSCINODISCUS SUBCONCAVUS Grunow var. JAPONICA var. nov. Plate 1, fig. 8.

Central space absent. Markings hexagonal, angular in contact. Apiculi distinct, large. Diameter of the valves 0.027 to 0.033 millimeter. Markings at the center 2.5 to 3 in 0.01 millimeter. Geographic distribution: *Coscinodiscus subconcavus* is known as a fossil from Simbirsk, A. Schmidt, Atlas Diatom. pl. 58, figs. 12, 13. Samples 5 and 6.

COSCINODISCUS PERFORATUS Ehrenberg. Plate 1, fig. 3.

A. SCHMIDT, Atlas Diatom. pl. 64, figs. 12 to 14.

Diameter of the valves 0.08 to 0.105 millimeter. Geographic distribution: Pacific Ocean, Mediterranean and North Seas. Samples 4 and 5.

DICHAMERIS VENTRICOSA Castracane. Plate 2, fig. 6.

Challenger Exped. Diatom. p. 150, pl. 12, figs. 5 to 6.

Valves lunate with broad, rounded dorsal and flat ventral margin. Markings distinct, radiate. Length, 0.085 millimeter; breadth, 0.057. Geographic distribution: Sea of Japan. Sample 3.

DITYLIUM BRIGHTWELLII (West) Grunow.

PERAGALLO, Diatom. Mar. France. pl. 46, figs. 6, 11.

Diameter of the valves 0.076 to 0.08 millimeter. Striæ 15 in 0.01 millimeter. Geographic distribution: Atlantic and Pacific Oceans. Sample 1.

BACTERIASTRUM VARIANS Lauder.

LAUDER, Hongkong Diatom. (1864) figs. 1 to 5.

Geographic distribution: Atlantic and Pacific Oceans. Samples 1, 3, and 4.

GRAMMATOPHORA ANGULOSA Ehrenberg var. HAMULIFERA Kützing.

PERAGALLO, Diatom. Mar. France. pl. 88, figs. 16, 17.

Length, 0.034 millimeter; breadth, 0.017. Striæ 18 to 20 in 0.01 millimeter. Geographic distribution: Atlantic and Pacific Oceans. Samples 1, 2, and 3.

GRAMMATOPHORA OCEANICA Ehrenberg var. MACILENTA Smith.

V. HEURCK, Synopsis. pl. 53, fig. 14.

Length, 0.132 millimeter; width, 0.01. Geographic distribution: Atlantic, North Sea. Samples 1 and 3.

GRAMMATOPHORA OCEANICA Ehrenberg var. ADRIATICA Grunow.

PERAGALLO, Diatom. Mar. France. pl. 87, fig. 19.

Length, 0.052 millimeter; width, 0.01. Geographic distribution: Atlantic and Pacific Oceans. Samples 1, 3, and 4.

GRAMMATOPHORA JAPONICA Grunow.

PERAGALLO, Diatom. Mar. France. pl. 87, fig. 26.

Length, 0.042 millimeter; breadth, 0.02. Geographic distribution: Sea of Japan. Samples 1, 3, and 4.

DIMEROGRAMMA MINOR Gregory.

V. HEURCK, Synopsis. pl. 36, figs. 10, 11a.

Length, 0.037 millimeter; breadth, 0.0085. Striæ 9 in 0.01 millimeter. Geographic distribution: Atlantic Ocean. Sample 5.

RHAPHONEIS SURIRELLA (Ehrenberg) Grunow var. AUSTRALIS (Petit) Grunow. Plate 3, figs. 1, 2.

V. HEURCK, Synopsis. pl. 36, fig. 27b.

Length, 0.042 millimeter; breadth, 0.02. Puncta 7 in 0.01 millimeter. Geographic distribution: Pacific Ocean. Sample 1.

RHAPHONEIS ELLIPTICA Castracane.

CASTRACANE, Diatom. Challenger. p. 49, pl. 26, fig. 13.

Length, 0.074 to 0.081 millimeter; breadth, 0.025 to 0.04. Striæ 4 to 6 in 0.01 millimeter. Geographic distribution: Sea of Japan. Sample 1.

SYNEDRA CRYSTALLINA Lyngbye var. CONSPICUA Grunow.

PERAGALLO, Diatom. Mar. France. pl. 79, fig. 4.

Length, 0.51 millimeter; breadth, 0.015. Geographic distribution: North and Mediterranean Seas. Sample 1.

THALASSIONEMA NITZSCHIOIDES Grunow.

PERAGALLO, Diatom. Mar. France. pl. 81, fig. 17.

Length, 0.027 to 0.029 millimeter; breadth, 0.002 to 0.0025. Striæ 9 to 10 in 0.01 millimeter. Geographic distribution: Atlantic and Pacific Oceans. Sea of Japan, China Sea. Samples 1 and 5.

COCCONEIS HETEROIDEA Hantzsch var. CURVIROTUNDA Tempere and Brun.

A. SCHMIDT, Atlas Diatom. pl. 195, figs. 10 to 17.

Valve elliptic. Length, 0.056 millimeter; breadth, 0.037. Geographic distribution: Japan fossil. Samples 1, 3, and 4.

COCCONEIS PELLUCIDA Hantzsch.

A. SCHMIDT, Atlas Diatom. pl. 195, figs. 7 to 9.

Valve robust, elliptic. Length, 0.081 millimeter; breadth, 0.059. Geographic distribution: Nicobar and Sandwich Islands, Java, Sumatra, Singapore, Bering Island, Madagascar, New Zealand, Hungary and Haiti fossil. Sample 1.

COCCONEIS PELLUCIDA Hantzsch var. MINOR Grunow.

Reise Novara, Algen. (1867) 13, pl. 1, fig. 7.

Valve broadly elliptical. Length, 0.032 millimeter; breadth, 0.022. Geographic distribution: Red Sea, St. Paul Island, Cape of Good Hope, Nicobar Islands, New Zealand, Trinidad. Sample 1.

COCCONEIS SCUTELLUM Ehrenberg var. GENUINA Cleve.

V. HEURCK, Synopsis. pl. 29, figs. 1, 2.

Valve elliptical. Length, 0.034 millimeter; breadth, 0.022. Geographic distribution: A cosmopolitan diatom. Sample 1.

NAVICULA JEJUNA A. Schmidt. Plate 4, fig. 7.

A. SCHMIDT, Atlas Diatom. pl. 46, fig. 76; CASTRACANE, Challenger, Voy. p. 33, pl. 20, fig. 12, pl. 28, fig. 11.

Length, 0.12 millimeter; breadth, 0.012. Striæ 4 in 0.01 millimeter. Geographic distribution: Java, Sumatra, Singapore, Makassar Strait, Japan. Sample 1.

NAVICULA YARRENSIS Grunow.

A. SCHMIDT, Atlas Diatom. pl. 46, figs. 1 to 6.

Valve lanceolate with obtuse ends. Length, 0.091 millimeter; breadth, 0.017. Striæ 4 in 0.01 millimeter. Geographic distribution: Brackish water. Kiel, Hungary fossil, Africa, Madagascar, Singapore, Ceylon, Java, Japan, Australia, Florida, Atlantic City, New Jersey, United States, Kamerun. Sample 1.

NAVICULA LYRA Ehrenberg var. INTERMEDIA Peragallo. Plate 3, fig. 7.

PERAGALLO, Diatom. Mar. France. pl. 27, fig. 6.

Length, 0.085 to 0.095 millimeter. Striæ 6 in 0.01 millimeter. Geographic distribution: North and Mediterranean Seas, Atlantic and Pacific Oceans. Sample 1.

NAVICULA LYRA Ehrenberg var. INTERMEDIA Peragallo forma ELLIPTICA Peragallo.

PERAGALLO, Diatom. Mar. France. p. 136, pl. 23, figs. 8 to 10.

Valve elliptical. Length, 0.119 millimeter; breadth, 0.039. Striæ 12 in 0.01 millimeter. Geographic distribution: Mediterranean Sea, Atlantic Ocean. Sample 1.

NAVICULA LYRA Ehrenberg var. ELLIPTICA A. Schmidt. Plate 3, fig. 9.

A. SCHMIDT, Atlas Diatom. pl. 1, fig. 29.

Valve elliptical. Length, 0.054 to 0.08 millimeter; breadth, 0.028 to 0.034. Striæ 8 to 9 in 0.01 millimeter. Geographic distribution: North, Mediterranean, and Red Seas, Ceylon, Madagascar, Seychelles, Sumatra, Philippines, Singapore, Moravia fossil. Sample 1.

NAVICULA FORCIPATA Greville.

A. SCHMIDT, Atlas Diatom. pl. 70, fig. 17.

Valve elliptical, with rounder, slightly subrostrate ends. Length, 0.042 millimeter; breadth, 0.02. Striæ 14 to 15 in 0.01 millimeter. Geographic distribution: Greenland, North, Mediterranean, Black, and Red Seas, Cape of Good Hope, Nicobar, Galapagos, and Philippine Islands, California, Florida, Hungary fossil. Sample 1.

NAVICULA BRASILIENSIS Grunow. Plate 3, fig. 12.

A. SCHMIDT, Atlas Diatom. pl. 6, figs. 19 to 25, 31 to 33.

Length, 0.039 to 0.076 millimeter; breadth, 0.02 to 0.032. Striæ 9 to 10 in 0.01 millimeter. Geographic distribution: Atlantic coast of North America, West Indies, Campeche Bay, Bra-

zil, Bab el Mandeb, Zanzibar, Madagascar, Ceylon, Singapore, Labuan, China, Japan, New Caledonia, Samoa, Sandwich Islands. Samples 1, 2, and 3.

NAVICULA GRANULATA Bailey var. JAPONICA var. nov. Plate 3, fig. 11.

Valve long-elliptic, with rounded ends. Axial area linear, narrowed towards the central nodule and the ends. Striæ 10 in 0.01 millimeter, slightly radiate throughout. Length, 0.075 millimeter; breadth, 0.027. Geographic distribution: The typical form is known from North and Mediterranean Seas, Ceylon, Japan, Sydney, California. Samples 1 and 2.

DIPLONEIS COFFÆIFORMIS A. Schmidt. Plate 3, fig. 10.

PERAGALLO, Diatom. Mar. France. pl. 21, figs. 7 to 9.

Valve broadly elliptical. Length, 0.024 to 0.025 millimeter; breadth, 0.015 to 0.019. Striæ 9 to 10 in 0.01 millimeter. Geographic distribution: North Sea, Gulf of Naples, Makassar Strait, California fossil. Sample 1.

DIPLONEIS FUSCA Gregory. Plate 3, fig. 6.

A. SCHMIDT, Atlas Diatom. pl. 7, fig. 4.
PERAGALLO, Diatom. Mar. France. pl. 20, figs. 5, 6.

Valve elliptical robust. Length, 0.064 millimeter; breadth, 0.037. Striæ 7 in 0.01 millimeter. Geographic distribution: Adriatic and Pacific Oceans. Samples 1 and 2.

DIPLONEIS SMITHII Brébisson. Plate 2, fig. 8; Plate 3, fig. 8.

Valve elliptical. Length, 0.04 millimeter; breadth, 0.024. Striæ 7 in 0.01 millimeter. Geographic distribution: Franz Josef Land, Spitzbergen, Sea of Kara, Finmark, Gulf of Bothnia, Baltic, North, and Mediterranean Seas, Madagascar, Seychelles, Tasmania, Java, New Zealand, Colon, Campeche Bay. Samples 1 and 2.

DIPLONEIS CRABRO Ehrenberg var. SUSPECTA A. Schmidt. Plate 2, fig. 9; Plate 3, fig. 13.

A. SCHMIDT, Atlas Diatom. pl. 11, figs. 12, 13, 26, 27.

Length, 0.076 millimeter; breadth, 0.025. Costæ 4 to 5 in 0.01 millimeter. Geographic distribution: Manila, Singapore, Java, Japan, Galapagos Islands, Batavia, Campeche Bay. Samples 1 and 2.

DIPLONEIS COARCTATA A. Schmidt.

A. SCHMIDT, Atlas Diatom. pl. 11, figs. 30 to 32.

Valve panduriform. Length, 0.04 millimeter; breadth, 0.015. Striæ 8 in 0.01 millimeter. Geographic distribution: Campeche Bay, Cape Horn, Hungary fossil. Samples 1, 2, and 4.

DIPLONEIS BOMBUS Ehrenberg. Plate 2, figs. 7, 10.

A. SCHMIDT, Atlas Diatom. pl. 69, figs. 28, 29.

Length, 0.039 millimeter; breadth, 0.018. Striæ 6.5 in 0.01 millimeter. Geographic distribution: Finmark, North Sea, Morocco, Mediterranean, Adriatic, Black, and Caspian Seas, Madagascar, Japan, Java, Samoa, Galapagos Islands, Cape Horn, Brazil, Florida and Campeche Bay. Sample 1.

CALONEIS BREVIS Gregory. Plate 3, fig. 14.

V. HEURCK, Synopsis. p. 97, pl. 11, fig. 19.

Valve elliptic. Length, 0.057 to 0.075 millimeter; breadth, 0.023 to 0.03. Geographic distribution: Spitzbergen, Greenland, Finmark, North Sea, Cape Deschneff, Sweden, Sydney. Sample 1.

CALONEIS LIBER W. Smith var. LINEARIS Grunow.

A. SCHMIDT, Atlas Diatom. pl. 50, figs. 38, 40.

Valve linear. Length, 0.085 millimeter; breadth, 0.017. Striæ 18 in 0.01 millimeter. Geographic distribution: Atlantic coasts of Europe, Africa, and America, Ceylon, Singapore, Galapagos Islands, Peru, Honduras, Gulf of Mexico. Sample 1.

TRACHYNEIS VELATA A. Schmidt.

A. SCHMIDT, Atlas Diatom. pl. 48, figs. 33 to 34.

Valve lanceolate. With obtuse rounded ends. Length, 0.081 to 0.011 millimeter; breadth, 0.01 to 0.023. Striæ 10 to 17 in 0.01 millimeter. Geographic distribution: Cape of Good Hope, Madagascar, Mauritius, Ceylon, King George Sound, Sumatra, Java, China, Sandwich Islands, New Caledonia. Samples 3 and 5.

TRACHYNEIS ASPERA Ehrenberg var. VULGARIS Cleve. Plate 4, fig. 9.

A. SCHMIDT, Atlas Diatom. pl. 48, figs. 2 to 6.

Length, 0.081 millimeter; breadth, 0.015. Striæ 9 to 10 in 0.01 millimeter. Geographic distribution: Arctic America, North Sea, Cape of Good Hope, New Zealand, Samoa, New Caledonia, Java, Galapagos Islands. Samples 1 and 2.

PLEUROSIGMA ELONGATUM Smith.

PERAGALLO, Monogr. Pleurosigma p. 7, pl. 3, fig. 6.

Length 0.24 millimeter. Striæ 18 in 0.01 millimeter. Geographic distribution: Brackish water. Spitzbergen, Atlantic coast of North America, North, Mediterranean, Adriatic, Baltic, and Caspian Seas, Sumatra, China, Tahiti, Medoc. Samples 1 and 2.

GYROSIGMA DIAPHANUM Cleve.

Synopsis Navic. Diatom. part 2, p. 115, pl. 1, fig. 6.

Length, 0.093 millimeter; breadth, 0.017. Geographic distribution: Brehat Island, Sweden, France. Samples 1 and 5.

AMPHORA ANGUSTA (Gregory) Cleve var. OKAMURÆ var. nov. Plate 4, figs. 5 and 6.

Valve narrow, semilanceolate, subacute. Dorsal and ventral sides of the valve striated. Length, 0.051 to 0.061 millimeter; breadth, 0.012 to 0.015. Striæ 12 in 0.01 millimeter. Striæ on the dorsal side 6 to 7 in 0.01 millimeter. Named in honor of Dr. K. Okamura, Tokyo. Samples 1 and 2.

AMPHORA PROTEUS Gregory.

A. SCHMIDT, Atlas Diatom. pl. 27, fig. 3.

Length, 0.047 millimeter; breadth, 0.011. Striæ 12 in 0.01 millimeter. Geographic distribution: Greenland, Spitzbergen, Finmark, Sea of Kara, Cape Deschneff, St. Helena, Campeche Bay, Mediterranean and Black Seas, Seychelles, China, Galapagos Islands. Samples 1, 2, and 5.

AMPHORA RHOMBICA Kitton.

A. SCHMIDT, Atlas Diatom. pl. 40, fig. 39.

Length, 0.178 millimeter; breadth, 0.023. Striæ 11 in 0.01 millimeter. Geographic distribution: Mediterranean Sea, Island of Rhea, Sumbawa, Sumatra, Makassar Straits, China, Colon. Samples 1 and 2.

NITSCHIA OKAMURÆ sp. nov. Plate 4, fig. 4.

Valve narrow lanceolate elongate ends. Ends not capitate. Length, 0.06 to 0.065 millimeter; breadth, 0.004 to 0.005. Fine lines 20 in 0.01 millimeter. Coarse dorsal lines 7 to 8 in 0.01 millimeter. Samples 1 and 2.

NITSCHIA SIGMA Smith var. INTERCEDANS Grunow.

PERAGALLO, Diatom. Mar. France. pl. 74, fig. 7.

Length, 0.102 to 0.24 millimeter; breadth, 0.005 to 0.006. Coarse lines 9 in 0.01 millimeter. Geographic distribution: Atlantic and Pacific Oceans. Samples 1 and 2.

NITSCHIA PUNCTATA Smith var. COARCTATA Grunow.

PERAGALLO, Diatom. Mar. France. pl. 59, figs. 26 to 30.

Length, 0.034 millimeter; breadth, 0.015 millimeter. Geographic distribution: Atlantic and Pacific Oceans, Yellow Sea. Samples 1 and 2.

NITSCHIA JELINECKI Grunow. Plate 3, fig. 4.

A. SCHMIDT, Atlas Diatom. pl. 330, figs. 20, 21.

Length, 0.2 to 0.3 millimeter; breadth, 0.01. Geographic distribution: Brackish and marine waters, Kamerun, Borneo. Samples 1 and 2.

NITSCHIA (TRYBLIONELLA) CALIDA Grunow.

PERAGALLO, Diatom. Mar. France. pl. 59, fig. 10.

Length, 0.068 millimeter; breadth, 0.013. Fine lines 18 in 0.01 millimeter. Geographic distribution: Brackish and marine waters. Sample 1.

NITSCHIA TRYBLIONELLA Hantzsch var. SUBSALINA (O'Meara).

GRUNOW, forma subconstricta Hustedt. Plate 3, fig. 3.

A. SCHMIDT, Atlas Diatom. pl. 332, fig. 15.

Length, 0.073 millimeter; breadth, 0.018. Coarse lines 7.5 in 0.01 millimeter. Geographic distribution: Brackish and marine waters. Sample 1.

NITSCHIA TRYBLIONELLA Hantzsch var. LEVIDENSIS Smith.

PERAGALLO, Diatom. Mar. France. Pl. 69, fig. 5.

Length, 0.03 millimeter; breadth, 0.008. Striæ 12 in 0.01 millimeter. Geographic distribution: Fresh and brackish waters. Sample 1.

SYNEDRA FASTUOSA Ehrenberg var. JAPONICA var. nov. Plate 4, fig. 3.

Valve broad ovate with rounded end; rim heavy, strongly crossbarred; ribs or costæ beginning at the margin are thin, bearing two or three minute teeth on the broad outer ends; short and very thin costæ connect the small internal ends of the costæ with a narrow median area, which is bounded by a closely set row of transverse lines. Length, 0.109 to 0.12 millimeter; breadth, 0.073 to 0.08. Samples 1 and 3.

SURIRELLA FASTUOSA Ehrenberg. Plate 3, fig. 5.

PERAGALLO, Diatom. Mar. France. pl. 58, fig. 5.

Length, 0.063 millimeter; breadth, 0.04. Geographic distribution: A cosmopolitan diatom. Samples 3 and 4.

CAMPYLODISCUS LORENZIANUM Grunow.

A. SCHMIDT, Atlas Diatom. pl. 14, fig. 24.

Diameter of the valves 0.022 to 0.027 millimeter. Costæ 5.5 in 0.01 millimeter. Geographic distribution: Mediterranean Sea, Celebes. Sample 1.

CAMPYLODISCUS SAMOENSIS Grunow.

A. SCHMIDT, Atlas Diatom. pl. 15, fig. 13, 15, 18, 20.

Diameter of the valve 0.107 millimeter. Geographic distribution: Atlantic Ocean, Mediterranean and Yellow Seas. Sample 1.

CAMPYLODISCUS HOROLOGIUM Will. Plate 4, fig. 11.

A. SCHMIDT, Atlas Diatom. pl. 17, fig. 5.

Diameter of the valves 0.09 to 0.095 millimeter. Geographic distribution: North and Mediterranean Seas, Sea of Japan. Sample 1.

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ILLUSTRATIONS

Plate 1

Fig. 1. *Coscinodiscus extravagans* A. Schmidt forma.
2. *Coscinodiscus radiatus* Ehrenberg.
3. *Coscinodiscus perforatus* Ehrenberg.
4. *Coscinodiscus excentricus* Ehrenberg.
5. *Coscinodiscus obscurus* A. Schmidt.
6. *Coscinodiscus okamuræ* sp. nov.
7. *Coscinodiscus marginatus* Ehrenberg.
8. *Coscinodiscus subconcavus* Grunow var. *japonica* var. nov.
9. *Arachnoidiscus ehrenbergii* Bailey var. *californica* Grunow.
10. *Actinoptychus parvus* Mann.

Plate 2

Figs. 1 to 3. *Auliscus coelatus* Bailey.
Fig. 4. *Biddulphia grundleri* A. Schmidt.
5. *Coscinodiscus curvatulus* Grunow.
6. *Dichameris ventricosa* Castracane.
7. *Diploneis bombus* Ehrenberg.
8. *Diploneis smithii* Brébisson.
9. *Diploneis crabro* Ehrenberg var. *suspecta* A. Schmidt.
10. *Diploneis bombus* Ehrenberg.

Plate 3

Figs. 1 and 2. *Rhaphoneis surirella* (Ehrenberg) Grunow var. *australis* (Petit) Grunow.
Fig. 3. *Nitschia tryblionella* Hantzsch var. *subsalina* (O'Meara) Grunow forma *subconstricta* Hustedt.
4. *Nitschia jelinecki* Grunow.
5. *Surirella fastuosa* Ehrenberg.
6. *Diploneis fusca* Gregory.
7. *Navicula lyra* Ehrenberg var. *intermedia* Peragallo.
8. *Diploneis smithii* Brébisson.
9. *Navicula lyra* Ehrenberg var. *elliptica* A. Schmidt.
10. *Diploneis coffæiformis* A. Schmidt.
11. *Navicula granulata* Bailey var. *japonica* var. nov.
12. *Navicula brasiliensis* Grunow.
13. *Diploneis crabro* Ehrenberg var. *suspecta* A. Schmidt.
14. *Caloneis brevis* Gregory.

Plate 4

Fig. 1. *Asteromphalus cleveanus* Grunow.
2. *Asteromphalus humboldtii* Ehrenberg.

FIG. 3. *Synedra fastuosa* Ehrenberg var. *japonica* var. nov.
4. *Nitschia okamuræ* sp. nov.
FIGS. 5 and 6. *Amphora angusta* (Gregory) Cleve var. *okamuræ* var. nov.
FIG. 7. *Navicula jejuna* A. Schmidt.
8. *Biddulphia longicruris* Greville.
9. *Trachyneis aspera* Ehrenberg var. *vulgaris* Cleve.
10. *Biddulphia longicruris* Greville.
11. *Campylodiscus horologium* Will.

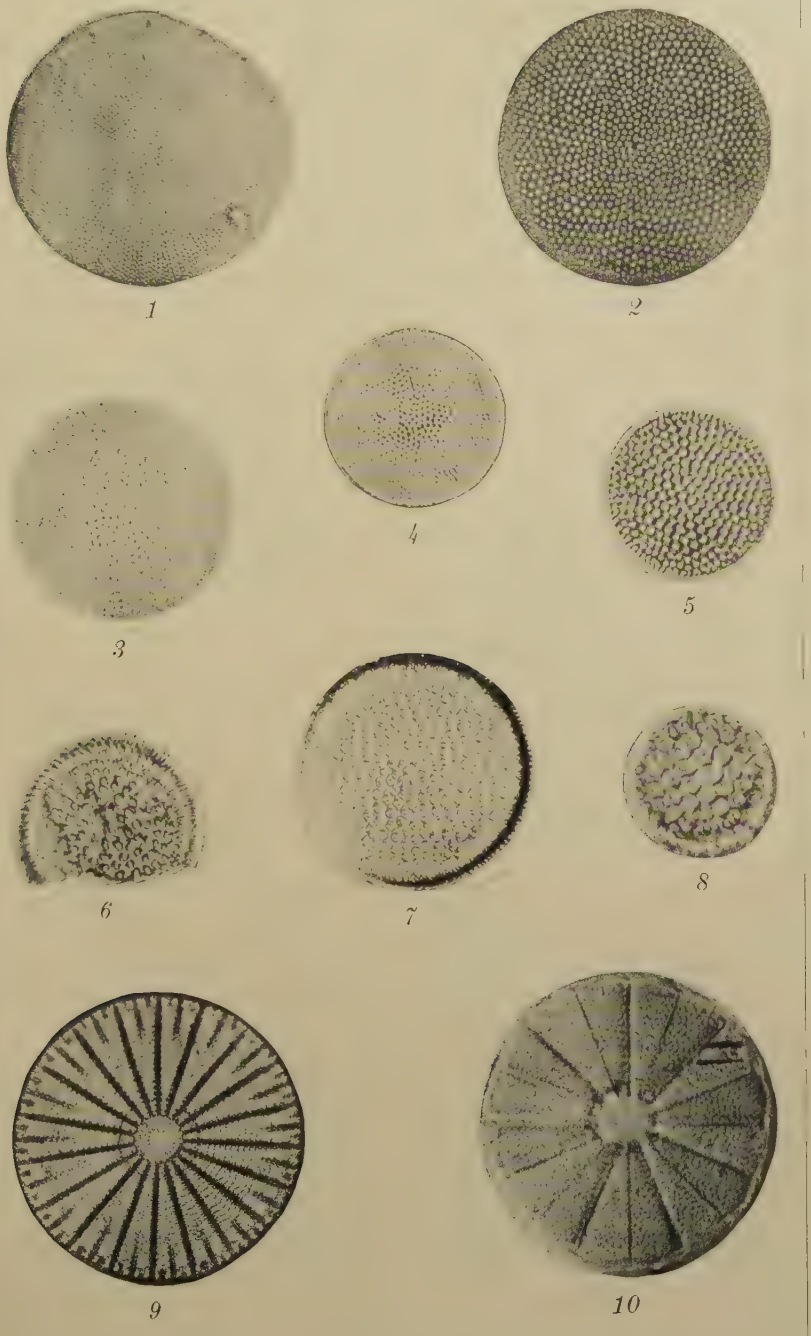
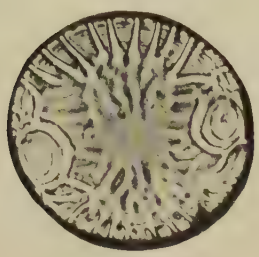


PLATE 1.



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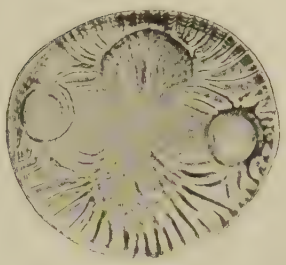

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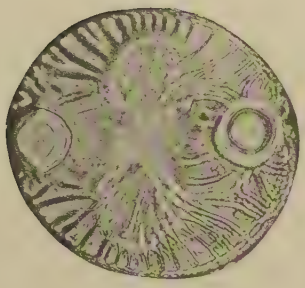

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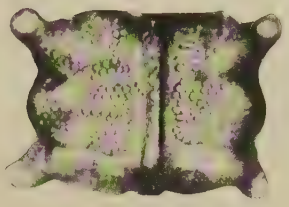

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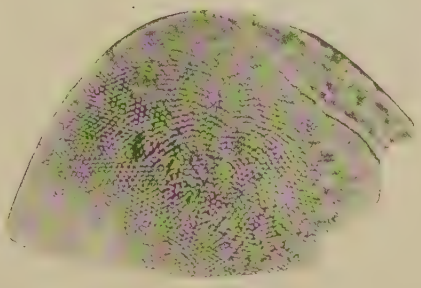

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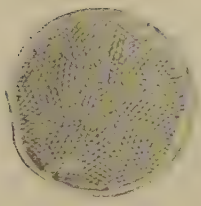

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PLATE 2.

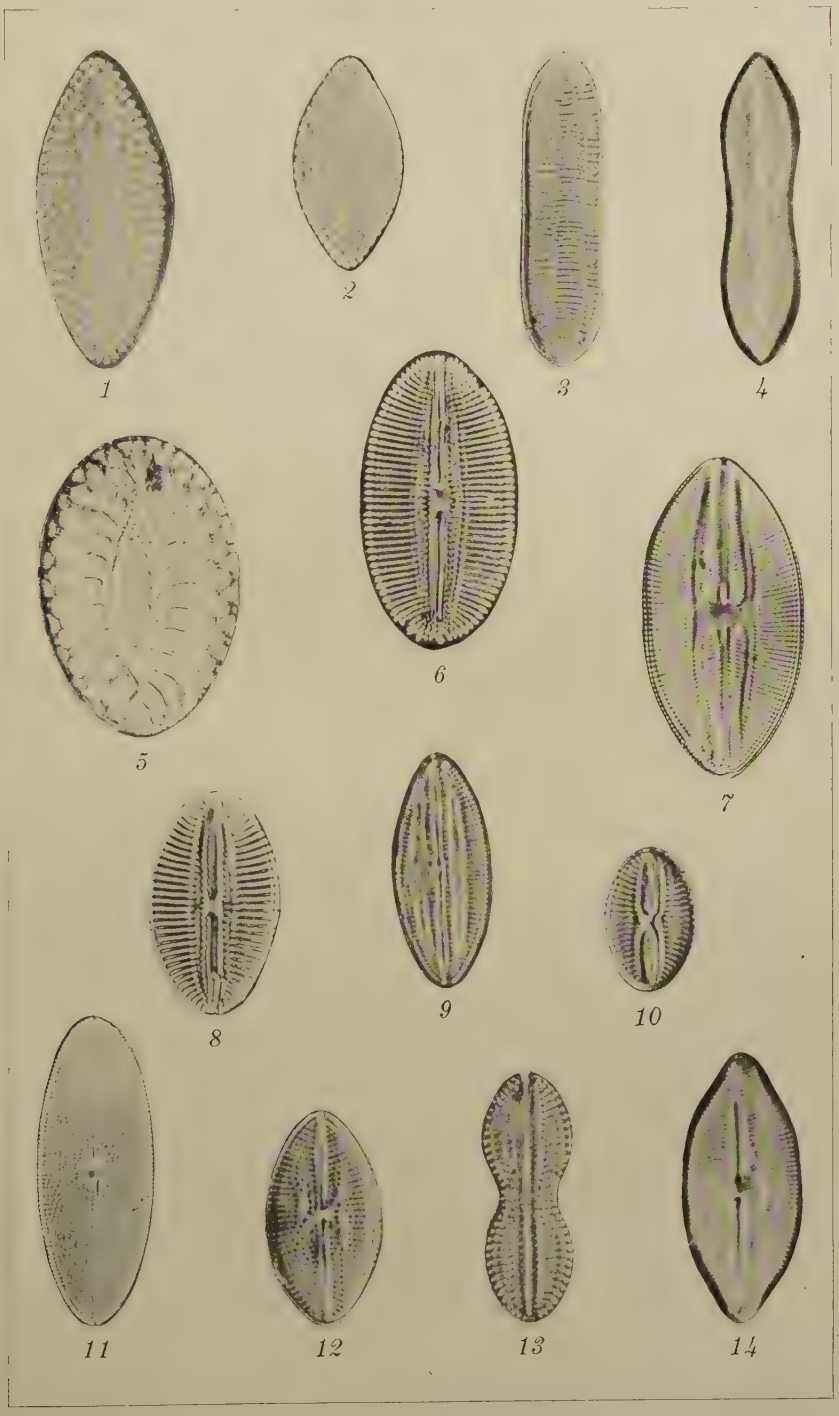

PLATE 3.

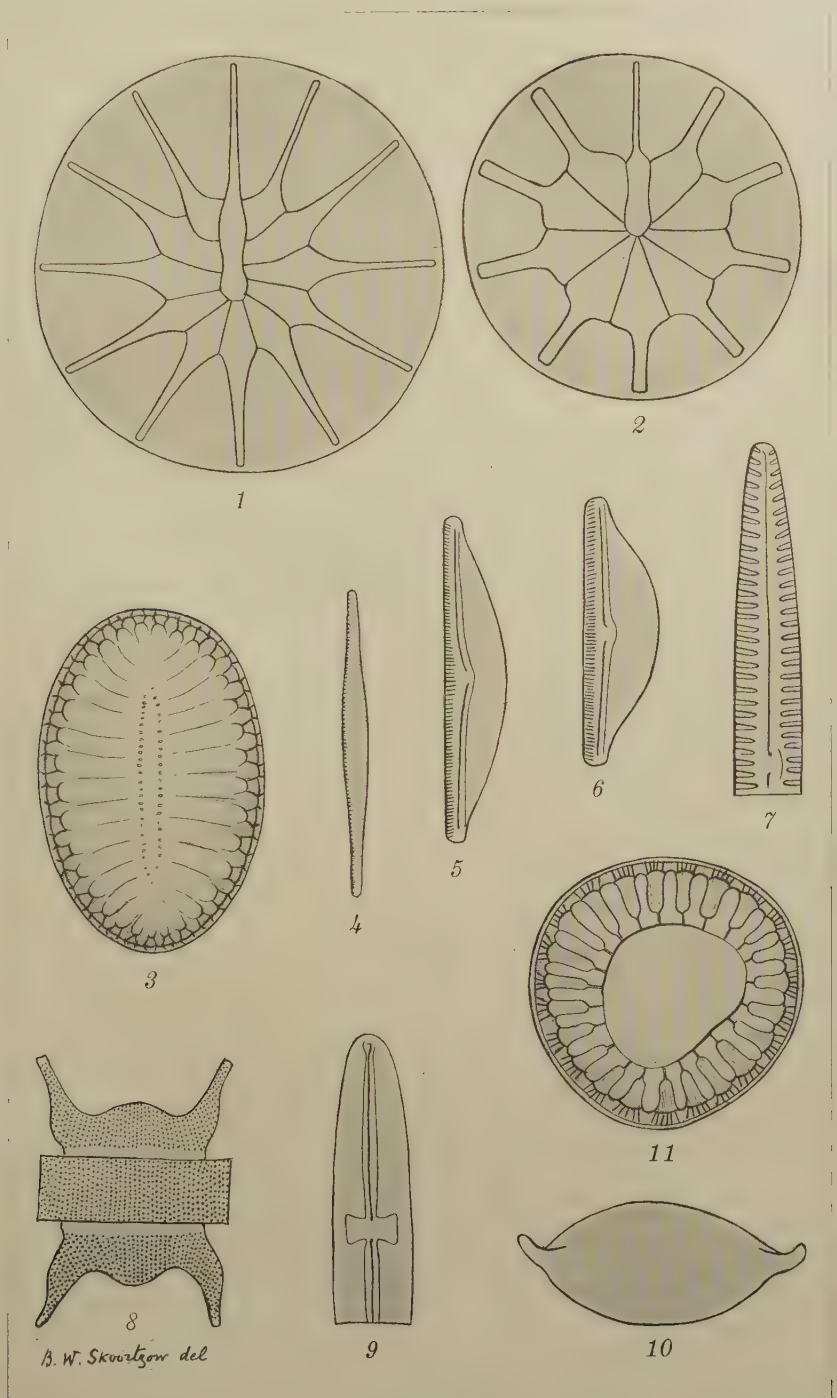

PLATE 4.

ANALYSIS OF SECTIONS OF SMALL AND MEDIUM-SIZED PHILIPPINE BAGTIKAN TREES, PARASHOREA MALAANONAN (BLANCO) MERRILL

By F. M. YENKO, LUZ BAENS, and AUGUSTUS P. WEST

Of the Bureau of Science, Manila

and

H. M. CURRAN

Of the Bureau of Forestry, Manila

TWO PLATES

The Philippine bagtikan trees [*Parashorea malaanonan* (Blanco) Merrill] are widely distributed in the Philippines. This species is one of the most abundant in the Islands. Recently we analyzed sections of the sapwood, heartwood, and core of both small and medium-sized bagtikan trees. Corresponding sections of these two trees gave quite similar analytical results for the chief constituents. In selecting bagtikan trees for analysis it would seem that any sound mature tree, whether small or of medium size, should give average representative samples.

The bagtikan tree sometimes grows to a diameter of 180 centimeters. The wood is of the lauan type. It is moderately hard and heavy, of coarse texture and has a durability of type IV. It seasons well with little checking and warping and is easy to work.

Bagtikan is used for ceilings, floors, doors, boxes, barges, furniture, and also for general cheap and temporary construction. An account of the structure of bagtikan, local names, and general properties is given by Schneider.[1]

EXPERIMENTAL PROCEDURE

A description of the bagtikan trees from which our wood samples were obtained is given in Table 1. Cross section logs were cut from about the middle of each tree. Sections of the sapwood, heartwood, and core were made from these logs.

[1] Philip. Bureau of Forestry Bull. 14 (1916) 167.

These sections were then heated in an air bath at 60° for about a day to eliminate most of the moisture and prevent the growth of fungi.

TABLE 1.—*Description of small and medium-sized bagtikan trees.*[a]

Measurements.	Small tree.	Medium-sized tree.
Diameter.....centimeters..	35.2	92.0
Total height.....meters..	22.2	46.53
Clear length.....do....	12.35	19.5
Length of crown.....do....	9.85	22.8
Average width of crown.....do....	6.0	19.21
Altitude above sea level.....do....	110.0	150.0
Habitat.....	Open.	Open.

[a] The small tree was cut from a pure stand of bagtikan seedlings located near the offices of the division of forest investigation, Los Baños. These trees were estimated to be about 40 to 50 years old. The diameter of the small tree was measured at breast height. The medium-sized tree was cut inside the Makiling National Botanic Garden along the bank of Molawin River just above the water intake. The diameter of the medium-sized tree was measured just above the buttress.

Samples for analysis were prepared from these sections by filing with a rasp. The wood filings were sieved and the portion that passed an 80-mesh sieve but was retained by a 100-mesh sieve was used for the analysis.

In analyzing the wood samples we used the standard methods [2] adopted by the United States forest products laboratory. Madison, Wisconsin. For moisture, cold-water soluble, alkali soluble, ether and alcohol extracts, ash, and nitrogen we followed, in general, the methods given by Schorger.

The cellulose was determined by the Cross and Bevan method.[3]

The apparatus used for chlorinating the wood samples was an ordinary desiccator that had two holes drilled in the top and also two holes in the side near the bottom. From a dropping funnel, hydrochloric acid was allowed to drop upon crystals of potassium permanganate contained in a filtering flask. The chlorine gas was conducted through a drechsel wash bottle containing sulphuric acid into the desiccator directly over the wood sample. Tap water was allowed to flow into the bottom of the desiccator through the lower hole in the side and to flow out from the other side hole which was somewhat higher. The flowing water absorbed the excess chlorine. After a three-

[2] Bray, M. W., Paper Trade Journ. 87 (1928) No. 25, 59. Schorger, A. W., Chemistry of Wood and Cellulose (1926) 505. Mayhood, S. A., Journ. Ind. Eng. Chem. 12 (1920) 873.

[3] Schorger, A. W., Chemistry of Wood and Cellulose (1926) 512.

minute interval the first chlorination was completed. The first stopcock was then turned and the excess chlorine in the generator was allowed to flow through two drechsel wash bottles containing sodium hydroxide solution. By turning the second stopcock a current of air entered the first hole in the top of the desiccator and after circulating through the desiccator passed through the second hole in the top and through a train of six wash bottles containing sodium hydroxide solution. The last wash bottle was connected to a vacuum pump. The excess chlorine gas was thus absorbed and not allowed to circulate in the laboratory.

When washing the cellulose, after the last bleaching with potassium permanganate and sulphurous acid, the cellulose was heated in water over a steam bath for two hours and filtered. This procedure was repeated until the filtrate gave a neutral reaction with methyl red. The cellulose thus obtained was found to be very white when dried at 105° C.

The lignin was determined by a modification of the method of Ost and Wilkening.[4]

The cellulose used for the determination of alpha-cellulose was prepared by the Cross and Bevan method. In following this method the cellulose was washed with hot water after the final bleaching with potassium permanganate and sulphurous acid. The cellulose was then transferred to a beaker and heated with water on a steam bath. It was again filtered and the washing process repeated until the filtrate gave a neutral reaction with methyl red. The cellulose was filtered through cheese cloth over a buchner funnel with the aid of suction. This procedure was found to be more advantageous than the use of an alundum filter cone, which appeared to absorb traces of acid. It was found that the presence of mere traces of acid in the cellulose gave a low result in the alpha-cellulose determination.

The determination of alpha cellulose was made according to the procedure given by Schorger. After adding the sodium hydroxide solution (17.5 per cent) and diluting at the end of a half hour, the mixture was centrifuged instead of filtered because the cellulose clogged the alundum filter and retarded filtration. After centrifuging, the hydroxide solution was decanted. The cellulose was then treated with NaOH solution (8 per cent) and once more centrifuged and decanted. After a further treatment in like manner with water and acetic acid

[4] Paper Trade Journ. 87 (1928) No. 25, 61.

(10 per cent) the cellulose was then filtered through a tared alundum crucible and washed with water until the filtrate was neutral to methyl red. This procedure was found to be very rapid and accurate.

In determining the hot-water soluble material, the sample was heated (reflux) for twelve hours instead of three.

The results of our analyses are recorded in Table 2.

TABLE 2.—*Analyses of sapwood, heartwood, and core of small and medium-sized bagtikan trees.*[a]

[Samples taken from middle section of tree.]

Constituent.	Small tree.			Medium-sized tree.		
	Sap-wood.	Heart-wood.	Core.	Sap-wood.	Heart-wood.	Core.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Moisture	4.81	2.37	7.34	6.48	6.49	7.60
Cold water soluble	1.98	1.58	1.61	2.98	0.36	0.40
Hot water soluble	4.05	1.75	2.58	7.20	6.94	1.10
Alkali soluble	13.05	11.32	12.72	11.74	13.92	8.52
Ether extract	0.51	1.74	2.53	0.54	1.30	0.77
Alcohol extract	2.32	2.55	3.03	3.11	1.82	1.65
Ash	0.84	1.02	1.08	0.93	0.97	1.08
Nitrogen	0.19	0.13	0.16	0.23	0.14	0.15
Cellulose	50.74	52.74	50.91	53.12	54.44	56.39
Ash in cellulose	0.49	0.87	0.82	0.68	0.65	0.53
Ash-free cellulose	50.25	51.87	50.09	52.44	53.79	55.86
Lignin	32.80	34.17	33.62	30.06	31.80	31.76
Alpha cellulose	77.36	80.00	74.75	79.42	76.98	79.05

[a] The percentages were calculated on a moisture-free basis. The percentages of alpha cellulose represent the amount of alpha cellulose determined in the pure cellulose. The small tree had a diameter of 35.2 centimeters and the medium-sized tree 92 centimeters.

RESULTS

As shown by the data (Table 2) the percentage of alpha cellulose in each tree was very high.

The sapwood, heartwood, and core of the small tree gave a slightly higher percentage of lignin and a slightly lower percentage of cellulose than the corresponding sections of the medium-sized tree.

Both the small and medium-sized tree gave approximately the same percentage of nitrogen and ash. Results with extractives were quite different for the two trees.

In selecting bagtikan trees for analysis it would seem from our results that any sound mature tree, whether small or of medium size, should give average representative samples.

TABLE 3.—*Relation of total extractives to cellulose and lignin.*[a]

Constituent.	Small tree.			Medium-sized tree.		
	Sapwood.	Heartwood.	Core.	Sapwood.	Heartwood.	Core.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Total percentage of extractives	21.91	18.94	22.47	25.57	24.34	12.44
Cellulose	50.25	51.87	50.09	52.44	53.79	55.86
Lignin	32.80	34.17	33.62	30.06	31.80	31.76

[a] The total percentage of extractives represents the cold- and hot-water and alkali-soluble extracts and also the alcohol and ether extracts.

In Table 3 is given a comparison of the total percentage of extractives with the percentages of cellulose and lignin. As shown by the data, the sapwood of the small tree contains a larger percentage of extractives than the heartwood. The percentage of cellulose and lignin in the sapwood of the small tree is smaller than the corresponding percentages in the heartwood. It appears that a section, which has a higher percentage of extractives than another section, usually has a lower percentage of cellulose and lignin. In comparing other sections of these bagtikan trees similar results are obtained. The excess of a particular constituent in a section seems to be balanced by a deficit in other constituents. Somewhat similar results were obtained in the analysis of the sapwood and heartwood of American trees.[5]

SUMMARY

Sections of the sapwood, heartwood, and core of a small and of a medium-sized bagtikan tree were analyzed. Corresponding sections of these two trees gave quite similar results for the chief constituents.

In selecting bagtikan trees for analysis it would seem that any sound mature tree, whether small or of medium size, should give average representative samples.

[5] Ritter, G. J., and L. C. Fleck, Journ. Ind. Eng. Chem. 15 (1923) 1055; 18 (1926) 576.

ILLUSTRATIONS

PLATE 1

FIG. 1. Apparatus for chlorinating wood samples.
2. A group of young bagtikan trees.

PLATE 2

An old bagtikan tree.

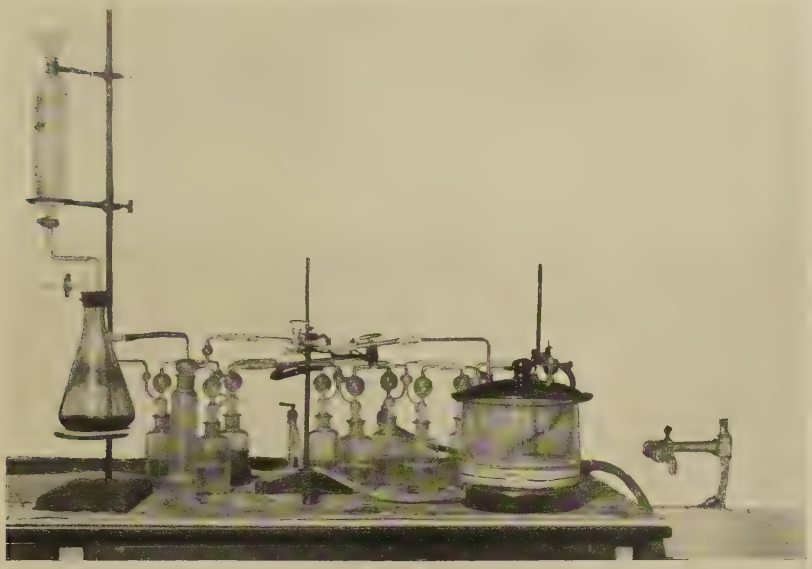

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PLATE 1.

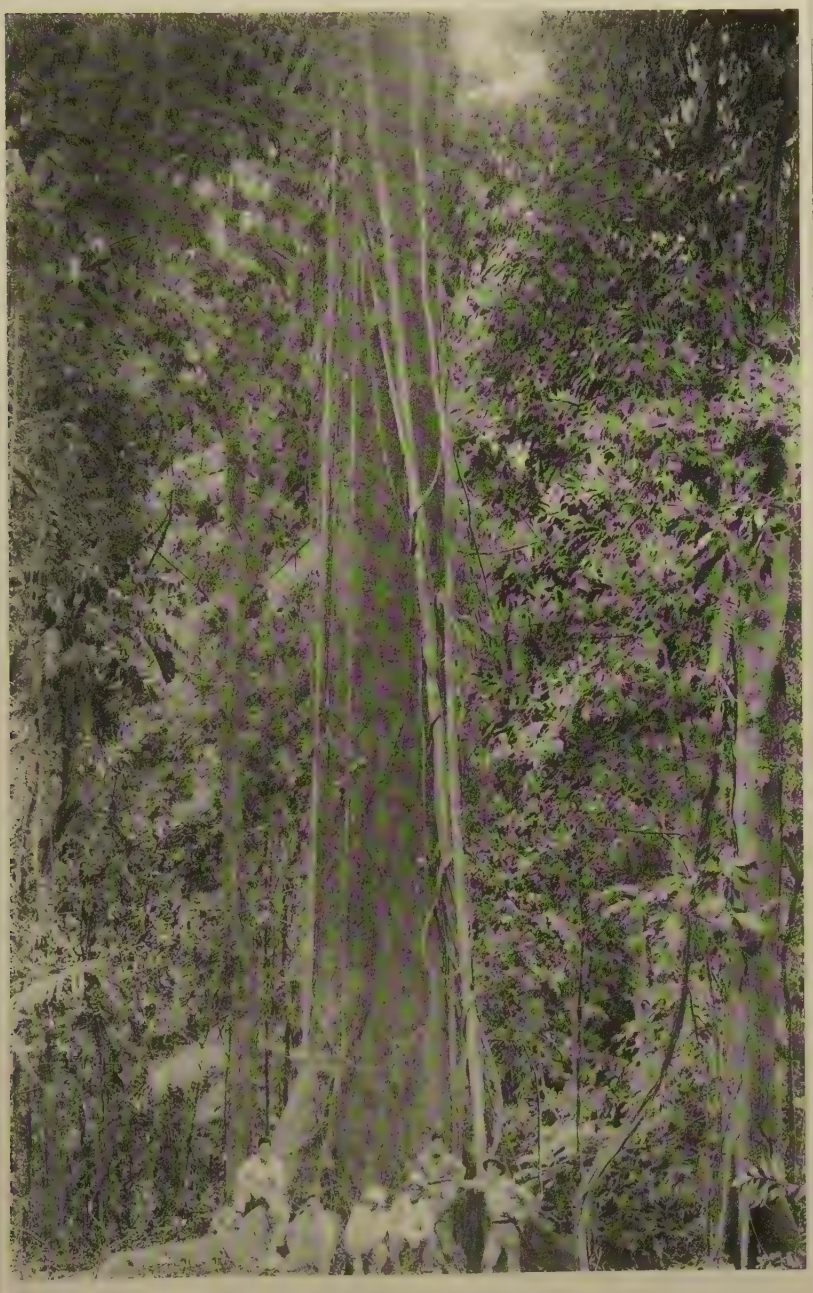

PLATE 2.

TWO NEW SPECIES OF SOOTY MOLDS FROM THE PHILIPPINES

By José M. Mendoza

Associate Mycologist, Bureau of Science, Manila

TWO PLATES

The sooty molds constitute the family Capnodiaceæ. In the Philippines, these fungi are of common occurrence and usually form a dense black coating on the surface of leaves, stems, branches, and fruits. They are always associated with species of woolly aphis or may occur on the droppings from these insects. They are more prevalent during the rainy season, and although they produce no appreciable ill effect upon the host, the photosynthetic activity of the plant is undoubtedly very much reduced.

The two following new species were noted while looking over a large number of undetermined ascomycetes which have accumulated at the Bureau of Science during the past decade or more.

SCORIAS PHILIPPINENSIS sp. nov.

Fungous colony amphigenous, but more abundant on the upper surface. Mycelium perisporoid, slimy, closely interwoven, weftlike, straw-colored to dark brown. Perithecia stalked, abundant, ovate or pyriform, obtuse or acuminate, seated on the fibers of the mycelium, 100 to 159 by 82 to 130 μ, greenish black; texture cellular-subradiate. Asci numerous, obovate to clavate, thick-walled, 8-spored, 40 to 57 by 12 to 13 μ; aparaphysate. Spores hyaline, cylindrical, tapering at one end, 3-septate, 21 to 23 by 3 to 4 μ. Pycnidia numerous, cylindrical, highly variable in size, 40 to 528 by 13 to 26 μ (Plate 1).

On *Ficus hauili*, Batangas Province, Luzon, Philippine Islands, *M. Ramos and Deroy, Bur. Sci. 22672* (type), April or May, 1915.

This species falls under *Scorias* Fries,[1] in having generic characteristics which are identical with it, or very nearly so. The type species is *Scorias spongiosa* (Schw.) Fr.[2] and is found in

[1] Syst. Orb. Veg. 1 (1825) 171.

[2] Ellis and Everhart, North American Pyrenomycetes (1892) 55, pl. 10, fig. 1.

North America. My fungus agrees in many respects with the description of the type; it differs, however, in having very much larger perithecia, pycnidia, asci, and ascospores. It differs also from *Scorias paulensis* P. Henn.[3] in the number of spores in the ascus; *S. paulensis* has 4-spored asci, while *S. philippinensis* has 8-spored ones. *Scorias capitata* Sawada[4] also differs from *Scorias philippinensis* in having 6- to 8-spored asci, while the species here described has only- 8-spored ones. The spores in *S. capitata* are obtuse at both ends; in *S. philippinensis* they taper at one end and round at the other.

PARASCORIAS SPINOSA sp. nov.

Fungus colony strictly epiphyllous. Mycelium dematioid, superficial, very gelatinous, from amber to dark brown in color, provided with blunt coarse spines, composed of much constricted, usually rounded but occasionally more or less cylindrical, cells; the rounded ones 3.2 to 11.5 μ in diameter, the cylindrical ones 8.0 to 9.6 μ long, 3.5 to 6.4 μ wide; mycelial branches tapering toward the end. Perithecia ostiolate, occasionally oval but generally almost cylindrical, very gelatinous, basal membrane composed of beaded mycelium, 60 to 143 by 41 to 47 μ. Asci numerous, cylindrical to club-shaped, thick-walled, 8-spored, 47.8 to 57.5 μ long, 15.5 to 16.5 μ wide; aparaphysate. Spores hyaline, cylindrical, tapering at one end, 1-septate, 14 to 16 μ long, 3 to 4.3 μ wide. (Plate II.)

On *Smilax* sp., Bucas Grande Island, Philippine Islands, *M. Ramos and J. Pascasio, Bur. Sci. 35931* (type), June, 1919.

This species falls under the genus *Parascorias* Mendoza.[5] The type of the genus is *Parascorias byrsonimae* Mendoza. The new Philippine species, although similar in many characters to *Parascorias byrsonimae,* which came from British Guiana, differs from it in having a mycelium provided with blunt and coarse spines, and is very gelatinous. The perithecia in *Parascorias byrsonimae* are globular to oval in shape while in *Parascorias spinosa* they are occasionally oval, but usually cylindrical, and very much larger. The asci in *Parascorias spinosa* are cylindrical or club-shaped, and are larger and much thicker than in *Parascorias byrsonimae,* in which they are ovate. The specific name has reference to the spiny character of the mycelium.

[3] Hedw. 48 (1908) 6.

[4] Nôjshikenjô Tekubet su Hôkoku (Special report, Agr. Exp. Sta.) Taiwan (Formosa), No. 11 (Feb., 1915) 123–124, pl. 4, figs. 19–23, T. 4, ii (Japanese).

[5] Ann. Mycol. 28 (1930) 366.

In addition to the two new species described above another interesting one was found among the Bureau of Science material. This was *Antennellina hawaiiensis* Mendoza, on leaves of *Ficus* sp., vicinity of Tangkulan, Bukidnon Subprovince, Mindanao, Philippine Islands, *E. Fenix, Bur. Sci. 26179,* July, 1916. The characteristics of the Philippine specimen are all identical with those of the type from Hawaii.[6]

ACKNOWLEDGMENT

The writer wishes to acknowledge the services of Dr. C. J. Humphrey, mycologist in charge of investigations in mycology and plant pathology, Bureau of Science, in reviewing the work and assisting in the preparation of the manuscript.

[6] Bernice P. Bishop Mus. Bull. 9 (1925) 55.

ILLUSTRATIONS

PLATE 1. SCORIAS PHILIPPINENSIS SP. NOV.

FIG. 1-a, 1-b. Pycnidia showing variable sizes.
2. Perithecium with ostiole and mycellum.
3-a, 3-b. Asci with eight ascospores.
4. Ascospores showing septation.
5. Mycelium showing characteristics of cells.
6. Photomicrograph of fungous colony.
7. Upper and lower surfaces of a leaf showing the presence of the fungus.

PLATE 2. PARASCORIAS SPINOSA SP. NOV.

FIG. 1. Perithecium showing ostiole and a portion of the beaded mycelium.
2. An ascus with 8 spores.
3. Three ascospores.
4a, 4b. Photomicrograph and drawing of a portion of the mycelium showing spines.
5. Photomicrograph of fungous colony.
6. Upper and lower surfaces of infected leaves.

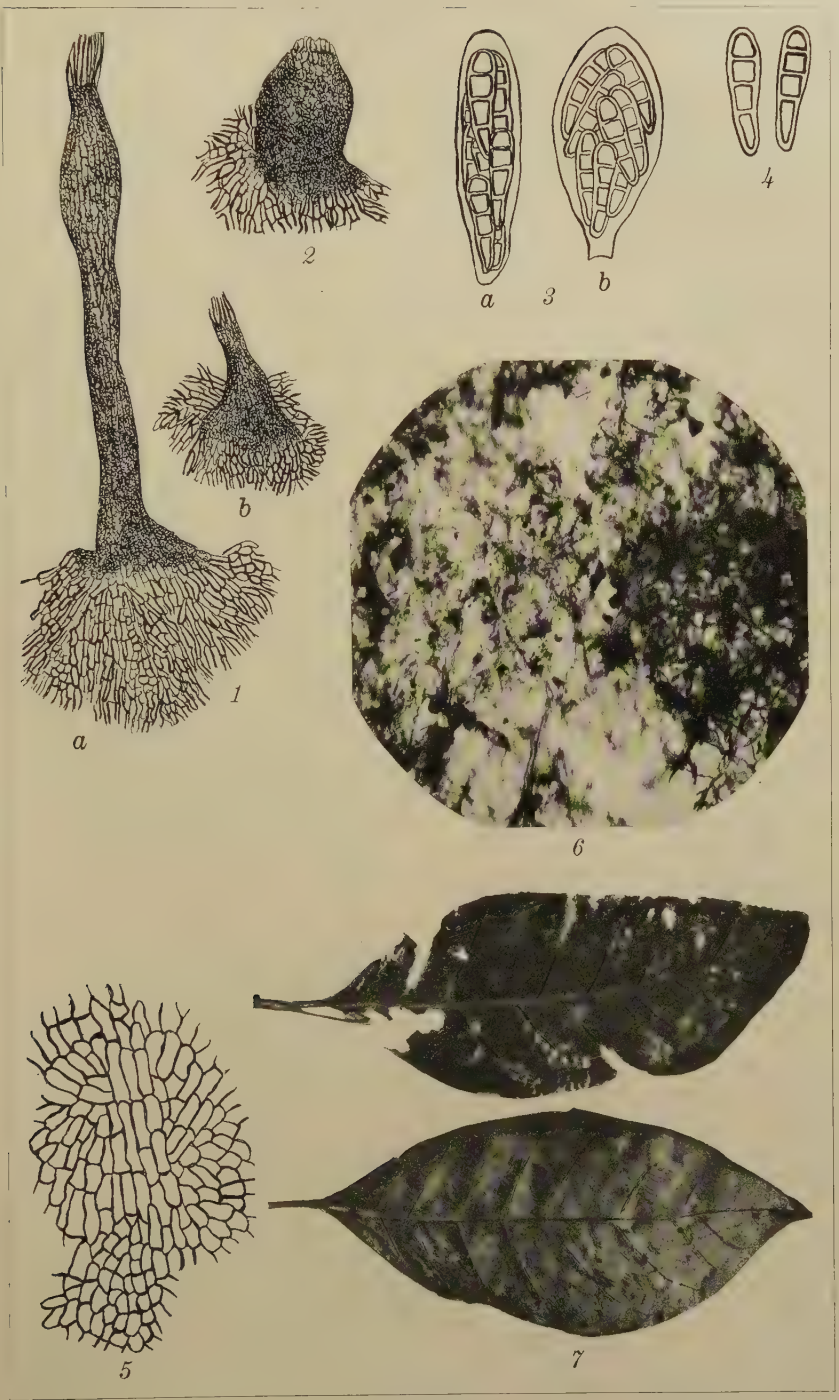

PLATE 1.

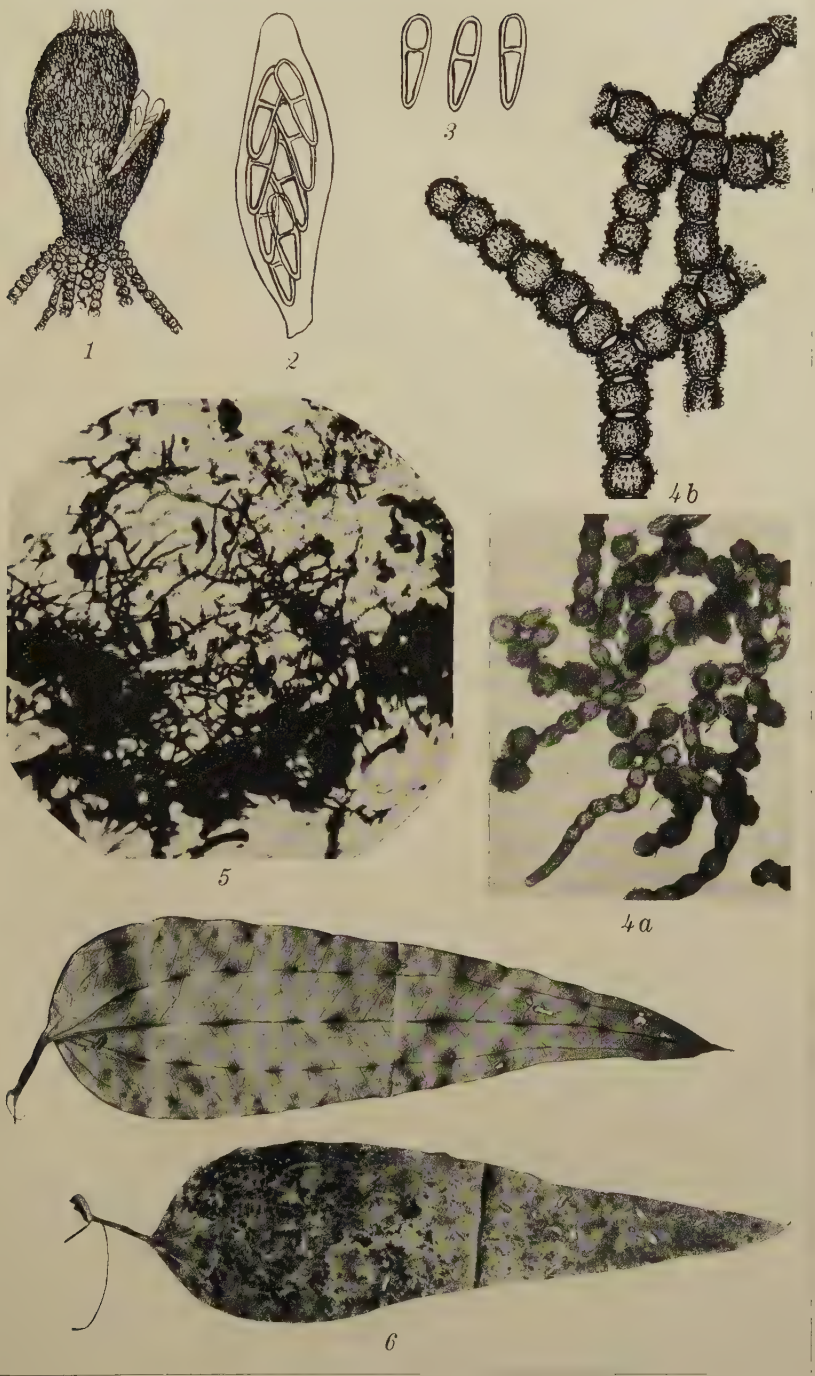

PLATE 2.

THE LATICIFEROUS VESSELS AND OTHER ANATOMICAL STRUCTURES OF EXCŒCARIA AGALLOCHA

By José K. Santos

Of the Department of Botany, University of the Philippines and of the Bureau of Science, Manila

FOUR PLATES

The main object of this brief investigation is to gain information concerning the nature and the distribution of the laticiferous vessels of *Excœcaria agallocha* Linnæus, and incidentally to have a description of the anatomical structures of its bark and leaf, where these latex tubes are located.

Excœcaria agallocha, locally known as *buta-buta* or *alipata,* is a shrub or small tree, of the well-known family Euphorbiaceæ, found distributed throughout the Philippine Archipelago along the seashore or within the influence of salt or brackish water. Practically all parts of this plant yield an acrid milky juice derived from the laticiferous vessels. This juice is so acrid, especially when fresh, that it blisters the skin, and when it gets into the eyes it produces intense pain and eventually blindness. In fact in India, where this plant also occurs, it is called the "blinding tree." In Malaya, according to Gimlette(2) the milky juice from buta-buta is administered internally as a poison by mixing it with the blood of the flying fox, the concoction producing strangury with hæmaturia and violent inflammation of the intestines. Dymock(1) states that in Australia and New Guinea, the milky juice obtained from the bark, when green, is used to cure ulcers, leprosy, etc. As far as the available literature is concerned the morphology of the laticiferous vessels of buta-buta, in which this poisonous acrid milky juice is lodged, and the anatomical structures of its bark and leaf have never been described. A brief study of these parts of the plant, therefore, is desirable not only for purely morphological reasons, but also in order to form a basis for the identification of the plant or parts of it in case of poisoning.

MATERIAL AND METHODS

The bark and leaves of *Excœcaria agallocha* used in this study were collected from Binauañgan, Bulacan Province, by Maximo

Ramos, a collector of the Bureau of Science. In March, 1931, he was sent to that place by Dr. Leon Ma. Guerrero, chief of the division of botany, Bureau of Science, to gather specimens of the bark and leaves of buta-buta for chemical analysis. A few pieces of bark and some leaves of this material were given to the author for this investigation.

Several transverse, radial, and tangential sections of the bark varying in thickness from 20 to 35 microns were prepared by means of a sliding microtome. The cells of these sections were found to have walls of a brownish color, and some had brownish contents. It was decided, therefore, to study them without staining. Some were simply mounted in water and examined, and others were mounted in dilute glycerine.

A portion of the bark was cut into small blocks about 1 centimeter long and 0.5 centimeter wide and macerated with warm 2 per cent solution of sodium hydroxide for one or two hours. The pieces of bark were washed thoroughly and the laticiferous vessels were carefully dissected, treated with solution of iodine, examined, and drawn. Several transverse sections through the midrib and surface preparations of the leaf were also made. These sections, like those of the bark, were examined in water and glycerine mount only without staining them.

THE BARK

The bark when dry is from 1 to 4 millimeters in thickness, and is either partially quilled with the two sides slightly rolled inward or overlapping quilled (Plate 2, fig. 9, *a–d*). Externally it is smooth or rough with numerous brown, rounded, axially or tangentially elongated lenticels. The color is grayish brown or greenish brown with some white patches of lichens or sometimes with some green algæ. Occasionally, some dark glistening resinous strips are observed on the outer surface. These resinous strips are due to dried latex exuded during the preparation of the bark. The periderm is thin and in some places near the edges of the bark it separates from the cortex. The inner surface is from light brown to dark brown or sepia color. It is smooth and finely striated longitudinally. The bark is strong and fibrous and bends when pressure is applied. The odor is not characteristic. The taste is slightly bitter and acrid.

Microscopical structure.—The external part of a transverse section of the bark is invested by a periderm which consists of two distinct regions; namely, the outer region or corky region,

and the inner region or phellogenetic region. The outer region is composed of several layers of thin-walled, suberized, and tightly compressed or tangentially flattened cells with a brownish substance in their small cavities. The inner region is built up of from 15 to 20 layers of empty, thin-walled, tangentially elongated and radially arranged phellogenetic cells. They are arranged more or less in concentric rows and are hyaline in character. Plate 3, fig. 10, represents a segment through the periderm showing the two distinct regions just described. The phellogen is distinct. The cortex is not sharply limited from the pericycle by a starch sheath. It is made up of several layers of tangentially elongated and irregularly arranged cells, most of which are filled with a brownish resinous substance (Plate 3, fig. 11, and Plate 4, fig. 28). Intermingled with these cortical parenchyma cells are some elliptical or rounded and usually larger structures. These are laticiferous vessels (Plate 3, fig. 16.) They are quite similar in general appearance to the parenchyma cells but are readily distinguished from the latter by their granular grayish content. Plate 3, fig. 11, shows a segment through the inner portion of the periderm and cortex, in which the characters of the cortical parenchyma cells and the laticiferous vessels are indicated. The pericycle consists mostly of parenchyma cells and a few slender bast fibers with thin and unlignified cell walls, hence it is not conspicuous (Plate 3, fig. 12). Scattered throughout the pericycle region there are also some laticiferous vessels. The bast region represents about one-third of the entire section. It is characterized by the presence of numerous uniseriate medullary rays that are distributed at intervals of almost every four cells. This region is composed primarily of phloëm cells, parenchyma, and laticiferous vessels. Towards the periphery some of the phloëm cells are often found collapsed into strands in which their outline and cell cavities are greatly deformed, and their identity is lost (Plate 3, fig. 12). Towards the cambial region, however, the phloëm cells are either polygonal or rectangular in outline (Plate 3, fig. 13). Intermingled with them are phloëm parenchyma cells that are very similar in appearance to the sieve tubes in cross section. Occasionally some of the parenchyma cells are found to contain prismatic calcium oxalate crystals (Plate 3, fig. 17). The laticiferous vessels are rather conspicuous in this region. They are either found mixed with the phloëm cells or between the medullary-ray cells as illustrated on Plate 3, fig. 13. The medullary rays are one cell wide and the medullary-ray cells are either

empty or filled with a resinous brownish substance. Occasionally some medullary-ray cells contain prismatic or cubical calcium oxalate crystals. Plate 3, fig. 15, is a segment of a medullary ray with two cells containing a round brownish resinous substance, and on the same plate, fig. 18, is another segment of a medullary ray showing two cells containing crystals of calcium oxalate.

In the longitudinal section of the bark, the elements of the periderm, as in the cross section, are differentiated into two regions, the cells of the outer region being suberized and filled with a brownish substance and those of the inner region being hyaline. The cortical parenchyma is likewise not sharply limited from the pericycle by a starch sheath, and most of the cortical parenchyma cells, as in the cross section, are filled with the brownish substance. Very often between the cortical parenchyma cells are laticiferous vessels which run parallel to each other. Bast fibers are occasionally observed. They are few and very long, measuring about 2.2 millimeters in length (Plate 4, fig. 29). The bast region is characterized by the numerous laticiferous vessels and by the one-cell wide medullary cells that are mostly filled with a brownish substance. The phloëm parenchyma cells are likewise mostly filled with the same substance or in some cases they are filled with solitary, monoclinic or prismatic calcium oxalate crystals forming a crystal fiber (Plate 4, fig. 27). Plate 3, fig. 14, represents a segment of the longitudinal section through the bast showing the parallel arrangement of the laticiferous vessels, the characters of the medullary cells, the phloëm parenchyma with brownish substance contents, the crystal fiber, and the relative position of the sieve tubes.

Anatomical structure of the leaf.—The lamina in a thin transverse section exhibits some interesting features. It is bifacial and about 0.8 millimeter thick. In its upper part it is limited by two layers of cells, the outer or upper layer being the epidermis and the lower layer the hypodermis. The outer epidermal cells are rectangular in shape with thick outer walls. The hypodermal cells are also rectangular in outline, but are slightly larger and have thinner walls on the outer as well as on the inner side (Plate 1, fig. 8, and Plate 4, fig. 24). The occurrence of this extra layer of cells on the upper part of the leaf in *Excœcaria agallocha*, according to Solereder,(6) was first observed by Herbert, who also noted that it occurs in species of various euphorbiaceous genera. On the lower part the thin section of

the lamina is bounded by a single layer of rectangular epidermal cells, the outer walls of which are thick, but comparatively thinner than those of the upper epidermal cells. The mesophyll is distinctly differentiated into palisade and spongy regions. The palisade region occupies about one-half of the upper part of the mesophyll. It consists of two layers of tubular palisade-chlorenchyma cells. The cells of the upper layer are twice as long as those of the lower layer. The lower or spongy region is built up of rounded, slightly elongated or irregularly shaped spongy-chlorenchyma cells supplied with rich air spaces. The veins or veinlets are embedded towards the upper part of this region. In these veins usually one or two laticiferous vessels are found intermingled with the phloëm cells or with the border parenchyma. Calcium oxalate crystals in rosette, cubical, or prismatic form are also observed lodged in some of the parenchyma cells on the outer part of the veins. They are sometimes found in rows in the longitudinal sections forming a crystal fiber (Plate 4, figs. 24 and 27).

The upper epidermis in surface view is composed of cells varying from 0.04 to 0.07 millimeter in length and from 0.02 to 0.04 millimeter in diameter. These epidermal cells are polygonal in outline with straight or slightly wavy, thick walls (Plate 4, fig. 25). The lower epidermis in the surface preparation is also built up of polygonal cells from 0.03 to 0.07 millimeter long and from 0.01 to 0.035 millimeter in diameter. Their walls are thinner than those of the upper epidermal cells, but they are also either straight, slightly bent, or faintly wavy. The stomata are large and numerous. They measure from 0.035 to 0.055 in length and from 0.025 to 0.035 millimeter in width, and are confined to the lower epidermis. The stomata are characterized by being accompanied on either side by one or more subsidiary cells that are pressed parallel to the pore. The integumental outgrowth is absent on either surface of the leaf (Plate 4, fig. 26). Another important feature of the leaf in the surface preparation of the epidermis is the occurrence of fine striation in the cuticle. This striation of the cuticle is observed only on the surface of the lower epidermal cells and is wanting on the surface of the upper epidermis. The striated lines run in various directions and usually emerge or radiate from the two sides of the different stomata.

A transverse section through the midrib reveals that the upper part is almost flat or very slightly convex, and the lower part is convex or rounded (Plate 1, fig. 8). The upper and

lower epidermal cells are nearly square or rectangular in outline or in some cases radially elongated. They are comparatively narrower or smaller than those of the blade (Plate 4, fig. 20 and 21). The hypodermis on the upper surface of the blade is not extended over the midrib. The upper collenchyma region consists of two or three layers of cells and occupies the upper portion of the midrib. The inner part is bounded by the cortical parenchyma. The lower collenchyma region is composed of three or four layers of thick-walled cells extended from one side of the midrib to the other, forming a sort of bandlike structure along the inner side of the lower epidermis. The collenchyma cells of both regions possess intercellular spaces. Very often collenchyma cells are observed to contain a resinous substance, and sometimes one or more laticiferous vessels are found mixed with them. The cortical parenchyma regions in the upper and lower parts of the meristele are composed of large, rounded or polygonal, thin-walled parenchyma cells with some intercellular spaces. Intermingled with these cells are some laticiferous vessels. The cortical parenchyma at the two lateral sides of the meristele are built up of small polygonal and thin-walled cells with or without intercellular spaces. On the other hand the parenchyma cells of the central portion of the midrib are either rounded or polygonal and have the general characteristics of the cortical parenchyma cells. The endodermis is not distinct and the sclerenchymatous elements are wanting. The meristele is divided into an upper and a lower region. The upper region is usually divided into four vascular bundles usually arranged in a horizontal position. The lower region is somewhat crescent-shaped and occupies a larger space. The phloëm consists of small, thin-walled sieve tubes and companion cells, and sometimes at intervals large parenchyma cells and laticiferous vessels are observed (Plate 4, fig. 23). The xylem is composed of vessels arranged regularly in radial rows. Between these rows are thin-walled and radially elongated parenchyma cells or medullary-ray cells.

The laticiferous vessels.—In connection with the course of development of the laticiferous vessels of members of the various tribes of the Euphorbiaceæ, according to Solereder,(6) Hanstein and Chauveaud have shown that these vessels are differentiated at a very early stage in the plane of the cotyledonary node, their initial cells being situated in the outermost cell layer of the central cylinder. These initial cells either compose the whole of this layer, or they are arranged in it in the form of four arcs.

Petch(4) states, however, that in *Hevea* and *Manihot* the laticiferous vessels are formed from rows of special cells, which are especially laid down by the cambium as latex cells. The cross walls that separate the cells are absorbed, and in this way a continuous tube is produced. This process is followed by the absorption of the lateral walls between two vertical rows of cells, so that the tubes communicate with one another laterally, resulting in the reticulate arrangement of the laticiferous vessels. In the case of *Excœcaria agallocha* there are no rows of special cells developed by the cambium that give rise to laticiferous vessels, nor is there a single latex tube observed that shows any sign of articulation. Its laticiferous vessels appear as continuous and independent tubes about 0.06 millimeter in diameter. These tubes branch occasionally and run more or less parallel through the cortical and bast regions of the bark, but they are especially numerous in the latter. They intermingle with the phloëm cells. In cross section, without their latex content, they appear very similar to the sieve tubes or perenchyma cells, but they are usually larger in size, have slightly thicker walls, and their granular and grayish latex readily distinguish them. However, in the longitudinal sections they are quite conspicuous and consist of continuous long tubes somewhat similar to those found by the writer(5) in the bark of *Alstonia scholaris*. They are either somewhat straight or crooked without a trace of articulations, as represented on Plate 3, figs. 14 and 19, *a-c*.

The latex tubes are also found quite abundant in the midrib and veins. In the former they are distributed in the cortical parenchyma, bast, and pith, while in the latter, they are simply mixed with phloëm cells and are less numerous, usually one or two only in each vein.

The latex content of the laticiferous vessels of *Excœcaria agallocha* consists of a milk-white liquid which, according to Hooper,(3) has an acid reaction and an odor like that of sour milk, mixes freely with water, coagulates below the boiling point, and precipitates when spirit is added. The specific gravity of the latex determined by him at 15° C. was 1.0718, and its chemical composition is as follows: Water, 61.94 per cent; resin, 28.85 per cent; soluble in water, 1.76 per cent; albumin soluble, 3.40 per cent; albumin insoluble, 4.05 per cent.

SUMMARY

1. In the bark, the laticiferous vessels of *Excœcaria agallocha* are scattered throughout the entire region except in the peri-

derm. They run more or less parallel to each other in the cortical and bast region of the bark, but are especially numerous in the latter.

2. In the leaf, the latex tubes are found quite abundant in the midrib and veins. In the midrib they are distributed in the cortical parenchyma, bast, and pith, while in the veins they are found mixed with the phloëm cells or with the border parenchyma.

3. The periderm is differentiated into two regions; the cells of the outer region are suberized, but those of the inner region are not.

4. The cortex is thin and not sharply limited from the pericycles by starch sheath.

5. The pericycle is not conspicuous and consists mostly of parenchyma cells and a few long bast fibers.

6. The bast region is traversed by one-cell wide medullary rays and most of the medullary cells contain a resinous brownish substance or solitary calcium oxalate crystals.

7. The leaf in cross section is bifacial and characterized by the presence of a single layer of hypodermal cells.

8. The stomata are confined to the lower surface and are characterized by being accompanied on either side by one or more subsidiary cells that are pressed parallel to the pore.

9. The cuticle of the lower epidermis in the surface preparation is characterized by fine striations which usually radiate from the two sides of the stomata.

10. The cross section of the midrib is almost flat above and convex below. The meristele is divided into two regions; namely, the upper region, consisting usually of four vascular bundles; and the lower region, which is more or less crescent-shaped.

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ILLUSTRATIONS

Plate 1. Excœcaria agallocha Linnæus

Fig. 1. Habit sketch of a portion of the plant, bearing male inflorescence; × 0.5.

2. Another habit sketch of a portion of the plant, bearing female inflorescence; × 0.5.

3. A sketch of a single leaf showing an irregular margin; × 0.5.

4. A young inflorescence; × 1.5.

5. A mature male inflorescence; × 1.

6. A small portion of the male inflorescence, showing the character of the anthers protected by bracts at the base; × 5.

7. A small portion of the female inflorescence, showing the characters of the young ovaries with their bracts removed; × 4.

8. A diagrammatic sketch of the cross section of the leaf through the midrib, showing, *ue*, upper epidermis; *h*, hypodermis; *pc*, palisade chlorenchyma; *s*, spongy chlorenchyma; *le*, lower epidermis; *c*, collenchyma; *uc*, upper conducting tissue; *lc*, lower conducting tissue; *lv*, laticiferous vessels; *rs*, resinous substance; *p*, parenchyma; × 25.

Plate 2. Excœcaria agallocha Linnæus

Fig. 9. Photograph of the dried bark.

Plate 3. Excœcaria agallocha Linnæus

Fig. 10. A segment of a transverse section through the outer portion of the periderm; *k*, cork cells; × 165.

11. A segment of a transverse section through the cortical region and a portion of the inner part of the periderm; *p*, phellogen; *lv*, laticiferous vessels; *rs*, resinous substance; × 165.

12. A segment of the transverse section through the inner portion of the pericycle and the outer part of the bast; *lv*, laticiferous vessels; *ph*, phloëm; *bf*, bast fiber; × 165.

13. A segment of a transverse section through the inner part of the bast, showing *m*, medullary rays; *lv*, laticiferous vessels; *ph*, phloëm; *rs*, resinous substance; × 165.

14. A segment of the longitudinal section through the bast, showing *lv*, laticiferous vessels; *co*, calcium oxalate crystals; *rs*, resinous substance; *m*, medullary ray cells; *st*, sieve tube; *phj*, phloëm parenchyma; × 165.

15. A segment of a transverse section through the medullary rays; *rs*, resinous substance; × 700.

16. A segment of a cross section cut through the cortical region; *lv*, laticiferous vessels; × 700.

FIG. 17. Two solitary calcium oxalate crystals from the phloëm parenchyma cells; × 700.

18. A segment of the medullary ray from a transverse section of the bark; *co*, calcium oxalate crystal; × 700.

19. Isolated laticiferous vessels drawn from the macerated section of the bark, *a–c*; × 275.

PLATE 4. EXCŒCARIA AGALLOCHA LINNÆUS

FIG. 20. A segment of a transverse section through the upper cortical region and epidermis of the midrib; *c*, collenchyma cells; × 220.

21. A segment of a transverse section through the lower collenchyma region and epidermis of the midrib; *c*, collenchyma; *rs*, resinous substance; × 220.

22. A portion of the transverse section through the upper conducting tissue of the midrib; *ph*, phloëm; *x*, xylem; *lv*, laticiferous vessels; × 220.

23. A portion of the transverse section through the lower conducting tissue of the midrib; *lv*, laticiferous vessels; *x*, xylem; *ph*, phloëm; × 220.

24. A portion of a transverse section of the blade; *ue*, upper epidermis; *h*, hypodermis; *pc*, palisade chlorenchyma; *s*, spongy chlorenchyma; *co*, calcium crystals; *v*, vein; *le*, lower epidermis; × 60.

25. A small portion of a surface view of the upper epidermis; × 220.

26. A small portion of the surface view of the lower epidermis; *st*, stomata; × 220.

27. A crystal fiber; *co*, crystal of calcium oxalate; × 220.

28. Isolated parenchyma cells containing resinous brown substance, *a–c*; × 220.

29. Isolated bast fibers, *a–b*; × 220.

PLATE 1.

PLATE 2.

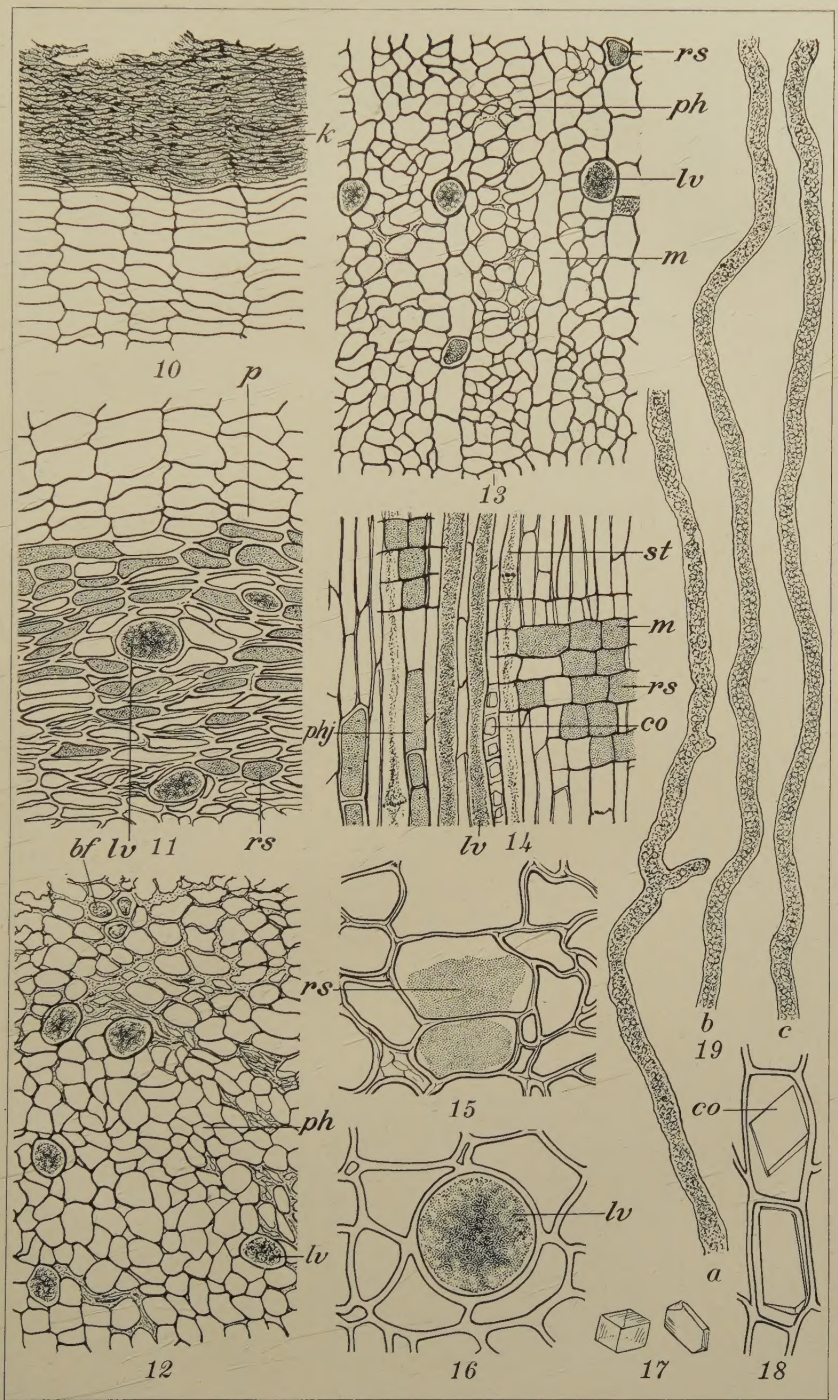
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PLATE 3.

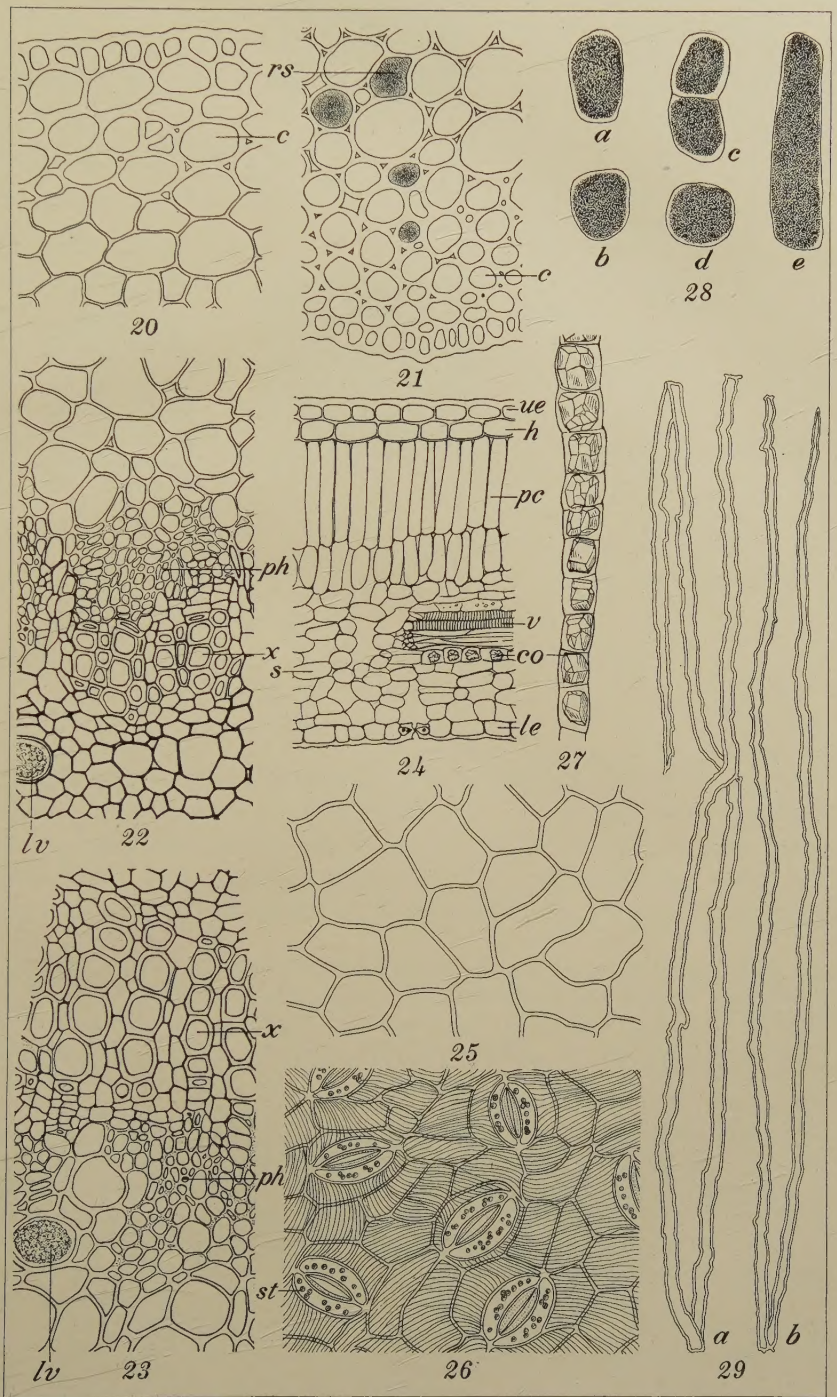
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PLATE 4.